NASA CONTRACTOR REPORT

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PROJECT MOON-BLINK

repared by

RIDENT ENGINEERING ASSOCIATES, INC.

ınapolis, Md.

Goddard Space Flight Center

TIONAL AERONAUTICS AND SPACE ADMINISTRATION • WASHINGTON, D. C. • OCTOBER 1966

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Prepared under Contract No. NAS 5-9613 by
TRIDENT ENGINEERING ASSOCIATES, INC.
Annapolis, Md.

for Goddard Space Flight Center

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

ABSTRACT

This final report on "Project Moon-Blink" describes work performed
by Trident Engineering Associates, Annapolis, Maryland, under con-
tract NAS 5-9613, dated June 1, 1965, for Goddard Space Flight
Center, Greenbelt, Maryland. This was the continuation and expan-
sion of the project initiated under Work Order No. 641-W-89329 (of
Trident's open-end task order contract NAS 5-3757) dated June 25,
1964.

The work consisted of 1) the development of devices to improve ob-
servation of unusual color occurrences on the moon in order to record
and identify such phenomena and 2) a lunar surveillance program via
telescope employing this especially designed equipment.

Trident personnel developed and fabricated a rotating-filter,
image-intensification instrument called a "Moon-Blink" device.
Using this device they maintained a constant surveillance at Port
Tobacco, Maryland, and observed several color phenomena. Photo-
graphic and spectrographic equipment was also installed at the
Trident Port Tobacco observatory. At the same time Trident engi-
neers fabricated and installed ten Moon-Blink detectors, they re-
cruited, trained, and supervised observers in other parts of the
country to form an observing network.

On November 15, 1965, the first photographs of a lunar color occur-
rence were made at the Port Tobacco observatory.

The following conclusions are based upon experience gained during
this effort.

1. Red colorations do appear on the lunar surface.

2. These colorations may persist for several hours. The Trident
    sighting, on November 15, 1965, lasted at least four hours
    (sunrise prevented further viewing).

3. The detection capability of the Moon-Blink device is much greater than direct viewing or conventional color photography.

4. The "Hot-line" technique (telephone conference network) is an effective means of alerting other observatories.

5. The effectiveness of unpaid volunteer observers is doubtful.

Summary of recommendations:

1. Since critical equipment was not available in government surplus, purchase of off-the-shelf items is recommended in order to permit completion of certain tasks.

2. Observations should be continued to realize the full potential of the Moon-Blink apparatus. The size, frequency, and nature of these phenomena should be determined for scientific information and as an aid to enhance the effectiveness of lunar landings.

T A B L E   O F   C O N T E N T S

APPENDIXES

INTRODUCTION AND BACKGROUND

1.1 PROLOGUE

There have been some puzzling reports over the years. Before
1843 astronomers listed Linne as a normal but steep-walled crater
about five miles in diameter. In 1866 Schmidt, a famed astrono-
mer, reported that Linne was not a crater at all but looked more
like a whitish cloud. Later observers disagreed with both de-
scriptions, saying it was a low mound, about four miles across,
with a deep crater one mile in diameter in its top.

Much later -- in 1961 -- Patrick Moore, one of the foremost con-
temporary lunar astronomers, was astonished that Linne appeared
to be a normal crater about three miles in diameter. Moore
examined it with two telescopes then called another astronomer.
He examined it with a third instrument and reported a similar
inexplicable appearance. The following night was cloudy, but
the next night Linne appeared as Moore had always seen it --
a gently rounded dome with a small crater on top. Moore attrib-
uted the changes to unusual lighting effects.

During the past ten years several incontrovertible observations
have been reported of unusual color activity on or just above
the lunar surface. These may be divided into two categories:
those events localized to a few square miles of lunar area and
those covering a significant portion of the lunar surface.

Insufficient evidence exists at present to determine whether
these two types of events are similar or dissimilar in nature.
However, they both manifest themselves in the red portion of the
visible spectrum. The localized observations to date have oc-
curred most frequently in two lunar areas: the Aristarchus
region and Alphonsus.

Appendix I of this report lists a number of modern observations which are peculiar because of color changes. Most were of short duration -- minutes or hours.

The detection of these transient events demands a program of constant surveillance of the moon with suitable astronomical instruments. This was strongly recommended by Dr. Z. Kopal at Commission 17 (The Moon) sponsored by the IAU and NASA at Goddard Space Flight Center on April 15-16, 1965. A surveillance program utilizing large astronomical telescopes inherently capable of detecting these occurrences is not feasible because of problems caused by economics and/or by prior commitments.

1.2 PROJECT "MOON-BLINK"

An intensive surveillance program consisting of a network of telescopes (with a 16-inch or larger aperture), suitably equipped, and manned voluntarily by capable amateur astronomers was established by Trident Engineering Associates under Goddard Space Flight Center Work Order No. 641-W-89329, dated June 25, 1964. This work order (covered by Trident's open-end task order contract NAS 5-3757) authorized Trident to develop a concept for a lunar transient color detector first conceived by Dr. James B. Edson of NASA Headquarters. This report concerns both that work order and the subsequent nine-month contract (NAS 5-9613, scheduled to terminate on February 28, 1966, and extended one month) which carried the project considerably further. On the following page are listed the tasks detailed in Contract NAS 5-9613 that were to be accomplished by Trident in developing both the detection system and the equipment. The detector and the program in which it has been utilized have been given the name "Moon-Blink."

DETAILED DISCUSSION

2.1 MOON-BLINK DETECTOR

The Moon-Blink detector is based on the principle that the eye's
attention will immediately be drawn by any movement occurring on
any part of a large, static image. In the Moon-Blink detector
the telescopic image is intercepted by alternating red and blue
filters at a rate of approximately 120 times per minute. When
this image is viewed by a suitable electro-optical device,
changes in color at either end of the visible spectrum will
appear as a "blink" on the face of the image tube, thus drawing
the eye to the spot. Figure 1 shows the detector components and
Figure 2 shows the device installed. A more complete description
of the Moon-Blink detector is included as Appendix II.

2.1.1 MOON-BLINK DEMONSTRATOR

To facilitate training of prospective observers, two Moon-Blink
demonstrators were constructed. These demonstrators consisted
of:

     a. A fluorescent light source, infrared filter, and
        suitable diffusing screen.

     b. A 35mm slide of the lunar surface with a small spot
        of red food dye applied at one location.

     c. A positive lens located to project an image of the
        35mm slide (with red dot) on the face of the image
        tube.

     d. A variable-speed, two-color filter wheel between the
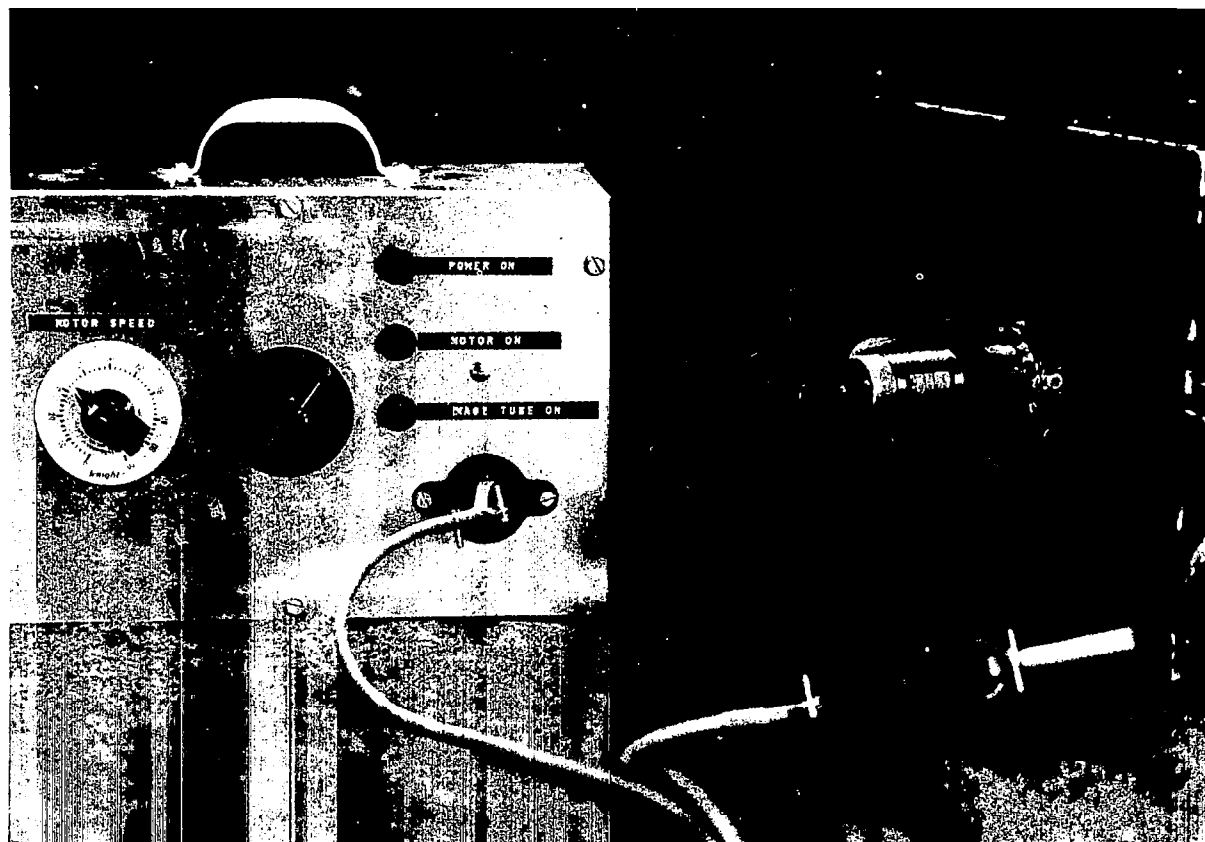   lens and the image tube.

Figure 1. Moon-Blink Detector components. Image tube mounted inside cylinder with eyepiece visible, motor attached to filter wheel (wheel inside rectangular housing), and power supply.
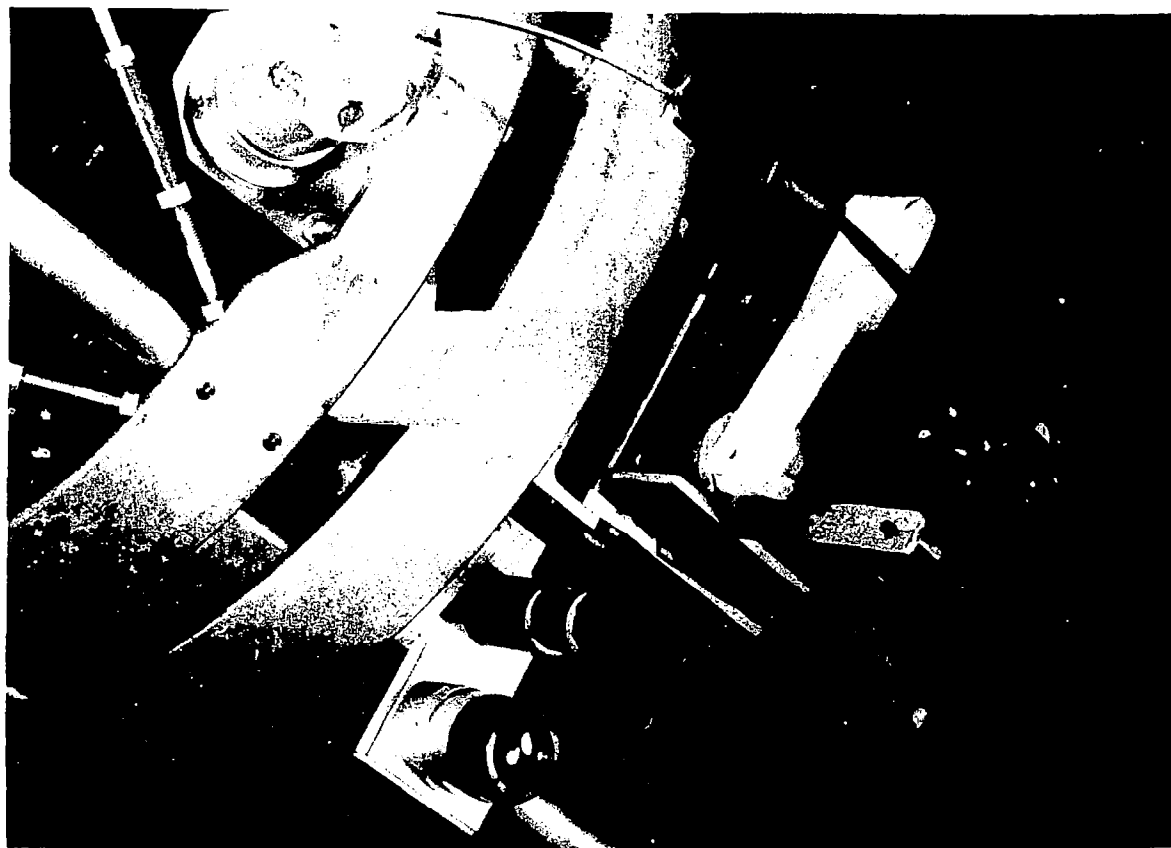
Figure 2. Moon-Blink Detector mounted on Johnson 16-inch telescope, Port Tobacco, Maryland.

With the filter wheel rotating, the image of the slide (as seen at the eyepiece of the image tube) appears to be a static black and white image, with the exception of the spot of red food dye, which appears to blink at the rate of the filter wheel rotation.

2.2 MOON-BLINK NETWORK

Trident installed the Moon-Blink equipment at eleven observatories across the country (listed below and shown on the map, Figure 3). First of these was the Johnson Observatory at Port Tobacco, Md., staffed by Trident personnel and established as the prime observation point.

MOON-BLINK NETWORK

Observatory	Location	Reflector
Johnson	Port Tobacco, Md.	16"
Monte Sano	Huntsville, Ala.	20"
Kansas City Astron. Club	Kansas City, Mo.	16"
Lunar & Planetary Lab.	Tucson, Arizona	16"
Stamford Museum	Stamford, Conn.	22" TV
Whittier College	Whittier, Calif.	19"
Celestronics	Palos Verdes, Calif.	22"
Foothill College	Los Altos, Calif.	16" TV
Bradley	Decatur, Georgia	30"
Pan American College	Edinburg, Texas	17"
Leander McCormick	Charlottesville, Va.	8"

2.3 "HOT-LINE" NETWORK

A "Hot-Line Lunar Transient Phenomena Confirmation Network" (actually a telephone conference-call net) was established. It connects three of the Moon-Blink Stations with selected major observatories. Thus, when sightings are made, these professional observatories can be quickly alerted to observe the event.

Los Altos

Stamford

Kansas City

Pt. Tobacco

China Lake

Charlottesville, Va.

Whittier –
Palos Verdes

Tucson

Huntsville

Decatur

Edinburg

Figure 3. Moon-Blink Station Network

"HOT-LINE" NETWORK

Observational Group	Location
Fels Planetarium	Philadelphia, Pa.
Flower & Cook Obs.	Philadelphia, Pa.
Georgetown Observatory	Washington, D. C.
Goddard Optical System	Greenbelt, Md.
Allegheny Observatory	Pittsburgh, Pa.
Harvard Observatory	Cambridge, Mass.
Johnson Observatory *	Port Tobacco, Md.
Sproul Observatory	Swarthmore, Pa.
U. S. Naval Observatory	Washington, D. C.
Bradley Observatory*	Decatur, Ga.
Leander McCormick Observatory*	Charlottesville, Va.
Arthur J. Dyer Observatory	Nashville, Tenn.
AAVSO	Mountainside, N. J.
AAVSO	Louisville, Ky.
Monte Sano Observatory*	Huntsville, Ala.
University of Maryland Observatory	College Park, Md.

*Also "Moon-Blink" Stations

2.4 PORT TOBACCO OBSERVATIONS

A continuous visual patrol of the moon has resulted in three "Moon-Blink" sightings of color events on the moon by Trident personnel. They were visually confirmed by at least three qualified observers. (Two additional sightings -- not visually confirmed by qualified observers and not listed below -- were also made during this period.)

October 27, 1964 Edgar D. Hall and Lyle T. Johnson detected a red spot at the base of the central peak of Alphonsus with the Trident Moon-Blink detector using the 16-inch reflector at Port Tobacco, Md.

August 21, 1965 John Gilheany and Lyle T. Johnson, Trident observers, detected a large-scale blink within the crater Aristarchus (not observable without Moon-Blink device) from Port Tobacco, Md.

November 15, 1965 Edgar D. Hall and David A. Nordling, Trident observers, detected a long-term blinking (4 hours) in the crater Aristarchus (not observable without Moon-Blink device). Color as well as black and white photos were taken of the event.

Details of the confirmed sightings by the Trident team are included as Appendix III.

2.5   MULTI-PURPOSE DETECTOR

2.5.1   PHOTOGRAPHIC CAPABILITY

The second priority of instrumentation at the Johnson Observatory was to achieve a reliable photographic capabiltiy. To implement this requirement, two 35-millimeter cameras of the single-lens, reflex type were procured and adapted for use on the 16-inch Johnson telescope.

The camera configuration was made sufficiently flexible that varying degrees of magnification (or effective focal length) were available. In general, the maximum effective focal length of 720 inches was used for most exposures.

Appendix IV discusses the photographic techniques in some detail, while Appendix V describes the film development techniques employed.

2.5.2   SPECTROGRAPHIC CAPABILITY

Several basic conceptual spectrograph designs were considered prior to the selection of the instrument described below.

Design requisites included modest cost; light weight; easy adaptability to a telescope mounting; minimum exposure time consistent with acceptable dispersive and resolution capabilities; and, finally, an instrument which would perform satisfactorily in the field when

used by observers relatively inexperienced in the use and handling of delicate optical instruments. A functional description of the spectrographic instrument is given in Appendix VI.

2.5.3 INFRARED CAPABILITY

For the purposes of heat measurement and analysis, the infrared phase of the multi-purpose detector can be positioned in the plane of the primary image of the telescope. The utilization of a rack-and-pinion type of mount permits positioning of the detector as required. Locating the detector at this position eliminates all glass elements in the light path.

The actual detector to be used is a two-element (one shielded), vacuum thermopile.

The outputs (one from window unit, one from shielded unit) can be alternately sampled and fed to an ac amplifier with its associated power supply. The amplified composite signal is then fed to a microvolt-ammeter.

Preliminary trials indicate that this arrangement yields usable measurements of lunar temperature when used in conjunction with the 16-inch telescope at the Johnson Observatory.

The major part of the above equipment is on hand. However, the actual configuration and calibration is still to be completed. A detailed description of the infrared technique is included as Appendix VII.

2.5.4 POLARIZATION CAPABILITY

The last item to be developed for the multi-purpose detector is the capacity to examine the light from the lunar surface to deter-

'mine the nature of its polarization, if any. The development and assembly of this instrument must await re-funding.

2.6 IMAGE ORTHICON INSTALLATION

High lunar contrast is essential to the detection of colored spots. It is extremely desirable, therefore, to employ an image orthicon television system by use of which the contrast, as viewed at the television screen, may be manually adjusted. Originally, an orthicon TV system was to have been provided from government surplus and installed at Port Tobacco. However, as explained in Paragraph 2.8, the system (even an adequate or marginal one) was not available. A functional description of the image orthicon installation is included as Appendix VIII.

2.7 AUTOMATIC DETECTOR

The automatic detector is conceived as a device to scan the lunar surface in search of color changes. If a change is detected, the automatic detector will trigger an alarm notifying observers who can then examine the phenomenon with the multi-purpose detector. Since the Image Orthicon System is a basic requirement of an automatic system, fabrication could not be effected. A functional description of the automatic system is included as Appendix IX.

2.8 PROCUREMENT OF SURPLUS MATERIAL

When the original work order under Trident's open-end contract and the Moon-Blink contract (NAS 5-9613) were negotiated, they provided for various Government Surplus items that were to be furnished in order to keep costs down. In Appendix X are listed those of the items that were either unobtainable or arrived in an unusable condition. The efforts to locate surplus material required by the project were largely guided and directed by the Regional Office of the

General Services Administration in Washington. This entailed many trips to Washington to screen lists of possible equipment and, in one case, a trip to Aberdeen Proving Ground to inspect material on site.

The most important of the items lacking was the image orthicon system. This system, actually a Bendix Lumicon, was received in such a deteriorated condition as to be beyond economical repair. And the six components of the Sage computer were so mutilated in disassembly as to be completely worthless. Several months of fruitless search left Trident and NASA representatives convinced that an image orthicon was either not available in Government Surplus or the priority of the project was not high enough to obtain one. Since the image orthicon system is an essential requirement of an automatic Moon-Blink device, this lack had a completely adverse effect on certain of the assigned contract tasks and disrupted the timetable to such an extent that approximately four months would be required to complete the contract after the purchase of the necessary items.

Both the Sage computer and the Bendix Lumicon were returned to Goddard Space Flight Center.

RESULTS

3.1 THRESHOLD OF DETECTION DETERMINED

A determination of the threshold of detection of the Moon-Blink equipment was made in the laboratory. This controlled experiment, described in detail in Appendix XI, determined that the Moon-Blinker can detect red or blue colorations that are on the order of only 2 percent brighter than the background.

3.2 DETECTION OF COLOR PHENOMENA

Transient lunar color phenomena have been detected on several occasions, as discussed in detail in Appendix III. In most of

these cases the observed phenomenon was not detectable without
the use of the Moon-Blink Detector, or even with microdensito-
meter analysis of photographs as discussed in Appendix XII. This,
especially when considered in conjunction with the laboratory evi-
dence discussed in 3.1 above, appears to establish definitely that
the Trident Moon-Blink Detector considerably enhances the prob-
ability of detecting a transient lunar color event.

THEORIES

Several theories to explain the origins of red spots on the lunar
surface have been suggested:

4.1 EXTERNAL CAUSES

a. Solar particle excitation of surface elements (Kopal).

b. Solar particle excitation of surface gasses.

4.2 INTERNAL CAUSES

a. Gentle outgassing from below the lunar surface.

b. Superficial cracks emitting gasses and subsurface

material.

RECOMMENDATIONS

5.1 CONTINUE PROJECT MOON-BLINK

It is strongly recommended that the Moon-Blink project be continued.

The desirability of continuing this project is clearly evidenced by the dramatic, successful sightings of transient lunar phenomena. The basic detection equipment (Moon-Blinker) has proven its value beyond doubt.

The record of responses by the various stations manned by volunteer observing team reveals that overall results of the Moon-Blink Network phase of the project have been rather disappointing. Such unpaid groups generally appear to lose interest after a time and deteriorate to one or two observers, at most, making occasional observations. Trident recommends that a system of remuneration either for individual observers or for the organization sponsoring the team be instituted in order to realize a fuller value from the organizational effort expended. Other incentive programs should also be investigated.

In regard to both the equipment development work and the primary observing program at Port Tobacco, Trident's team is pre-eminently qualified to continue the work to a favorable completion, by virtue of past experience with the program as well as of recent successes such as the November 15ᵗʰ sighting of the red coloration in the crater Aristarchus.

APPENDIX I

LIST OF SIGNIFICANT OBSERVATIONS

October 26, 1956

Dinsmore Alter photographed Alphonsus in the violet-blue portion
of the visible spectrum and in the infrared. He noticed a blur-
ring of the floor of Alphonsus in the photograph in the violet-
blue which did not appear in the infrared. This observation can
be attributed to the temporary presence of a localized atmosphere
in Alphonsus.

November 3, 1958

N. A. Kozyrev obtained an emission spectrum from the central peak
of the crater Alphonsus with the 50-inch reflector at the Crimean
Astrophysical Observatory.

October 23, 1959

N. A. Kozyrev again obtained a spectrum from the region of the
central peak of Alphonsus which he interpreted as indicating an
unusual activity occurring.

October 29, 1963

James Greenacre and Edward Barr of the U. S. Air Force Aeronautical
Chart and Information Center observed bright spots in Aristarchus
and along Schröter's Valley with the 24-inch refractor at the
Lowell Observatory.

November 3, 1963

Zdenek Kopal photographed a luminescence of a significant portion
of the lunar surface using narrow band pass filter techniques.

November 27, 1963

Greenacre, Barr, and associates again observed bright red spots in
Aristarchus and Schröter's Valley.

October 27, 1964*

Edgar D. Hall and Lyle T. Johnson, Trident observers, detected a
red spot at the base of the central peak of Alphonsus with the
Trident Moon-Blink detector on the 16-inch reflector at the Johnson
Observatory, Port Tobacco, Maryland.

August 21, 1965*

John Gilheany and Lyle T. Johnson, Trident observers, detected a
large-scale blink within the crater Aristarchus (not observable
without Moon-Blink device) from Johnson Observatory at Port Tobacco,
Maryland.

November 15, 1965*
Edgar D. Hall and David A. Nordling, Trident observers, detected
long-term (4 hours) blinking in the crater Aristarchus (not observ-
able without Moon-Blink device) from Johnson Observatory at Port
Tobacco, Maryland. Black and white and color photos were taken
during the observations.

References

Lunar Color Phenomena, ACIC, Technical Paper No. 12, USAF Aeronautic
Chart & Information Center, St. Louis 1, Missouri, 63118, May 1964.

Pictorial Guide to the Moon, Dinsmore Alter, Thomas Y. Crowell Co.,
New York, 1963.

Physics and Astronomy of the Moon, edited by Zdenek Kopal, Academic
Press, New York and London, 1962.

Sky and Telescope, pp. 184-186, February 1959.

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*Details given in Appendix III.

APPENDIX II

FUNCTIONAL DESCRIPTION OF TYPICAL MOON-BLINK DETECTOR

The Moon-Blink detector ("Moon-Blinker") is a combination of the
two-color photographic and blink microscope techniques, and it
allows immediate indications without waiting for any processing
steps. The device operates in the following manner:

A. A rotating filter wheel is placed in the optic axis of the
telescope just ahead of the usual eyepiece location. This
filter wheel is so constructed as to alternately place a
red and a blue filter in the light path at a rate of 4 to
12 times per second. When the moon is in its normal condi-
tion (i.e. black, white, and shades of grey), the red and
blue images have about the same intensity. Should there be
a small spot of red on the surface, however, it would seem
quite bright on the red image and very nearly black on the
blue image. With the filter wheel rotating, the colored
spot would change from bright to dark at the same rate at
which the wheel is rotating. In other words -- it would
seem to blink on and off. Of course, if one were to insert
an eyepiece and look at this image, not only would the
"blinking" of any small spot tend to be obscured by the fact
that the lunar surface was changing from red to blue at 4
to 12 times a second, but this would also give the observer
a very respectable headache in short order. We need a means
of removing the background color changes.

B. For this reason an electronic image tube is placed between
the filter wheel and the eyepiece. This device is essentially
an electronic black and white emulsion. Physically, it is
a cylinder 1½ inches in diameter and a little over 2 inches
long. At one end is a photocathode (with an S-20 response)
on which the alternating red and blue images of the moon are
projected. The image tube then transfers the colored images
on the cathode to a viewing screen at the other end of the
cylinder where an exact (but brighter) black and white copy
of the original image is reproduced. By placing suitable
grey filters in series with the red or blue filters, the
intensity of the viewed image on the image tube can be made
the same for the red and blue images. Thus, when the moon
is normal, a steady black and white image is viewed on the
image tube screen while the filter is rotating. But any red
spots on the moon would appear to blink at the rate of rota-
tion of the image tube. The tube chosen (a slightly modified

RCA 6914) has the advantage of nearly the ultimate in simplicity since only a single, steady voltage is applied to it, and the resolution (80 line pairs per millimeter) is better than most fine-grain photographic films. As mentioned earlier, the image tube used has some light intensifying ability -- about 25 times, in fact. This intensifying effect more than compensates for the light loss due to the filters.

Specific parameters of the Moon-Blinker are as follows:

A. Eyepiece -- A Bausch and Lomb 7-power Triplet magnifier is used as an eyepiece to view the phosphor screen of the image tube.

B. Image Tube -- A factory modified RCA 6914 image tube is used. The modification consists of an S-20 photo cathode instead of the normal S-1 photocathode, offering a response to visible wavelengths, increased sensitivity, and increased resolution.

C. Image Tube Housing -- The image tube is housed in a Plexiglas cylinder, and the interior voids are filled with a silica potting compound (Sylgard 169).

D. High Voltage Power Supply -- A high voltage source to supply the 16,000 volts of direct current required to operate the image tube is potted inside the Plexiglas cylinder with the image tube. This supplies needed protection to prevent operators from coming in contact with this voltage. The high voltage supply consists of a 12-stage voltage multiplier, as shown in Figure II-1.

The rectifiers used are 2000 Peak Inverse Voltage solid state units supplied by Varo Inc. as a single unit of 12 rectifiers. The capacitors are all 0.01 microfarad, 3,000-volt ceramic units. The assembled power supply is the size of a book of paper matches.

E. Filter-Wheel -- The filter wheel is a six-inch, hub-driven wheel one half of which is made up of Blue Wratten 44-A filter and the other half Red Wratten 29 filter. As an alternate approach to filter wheel

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construction, some Rohm & Haas 1/8-inch acrylic plastic was
procured. It was found that the red (#2129) and blue (#2152)
plastic had cut-off wavelengths identical to the Kodak Wratten
#29 and 44-A filters. Figure II-2 is a comparison of the
spectral characteristics of these four filters. Although the
plastic is not of true optical quality, it compares very
favorably with the gelatin filters which tend to warp. At
the present time, Trident feels that the plastic produces
the best filter wheel.

F. Motor -- The motor can be any small, variable speed dc motor
such that it can hub drive the filter wheel at the desired
speed   The motor pictured in Figure 1 (page 5) is a 28-
volt, dc motor with integral gear train.

G. Low Voltage Power Supply -- The low voltage power supply
furnishes 700 volts ac to drive the voltage multiplier and
suitable voltage to drive the motor. The low voltage power
supply pictured in Figure 1 includes provisions for switch-
ing to image tube, filter wheel, or both as well as provi-
sions to vary the voltage supplied to the motor.

H. Reliability -- In order to achieve reliability, all fabri-
cated Moon-Blinkers are heated to 93°C, quickly cooled to
-10°, and then subjected to critical electro-optical per-
formance tests.

HIGH VOLTAGE POWER SUPPLY

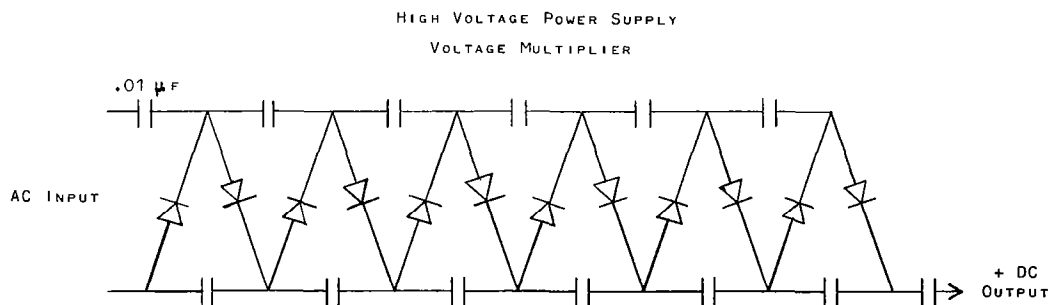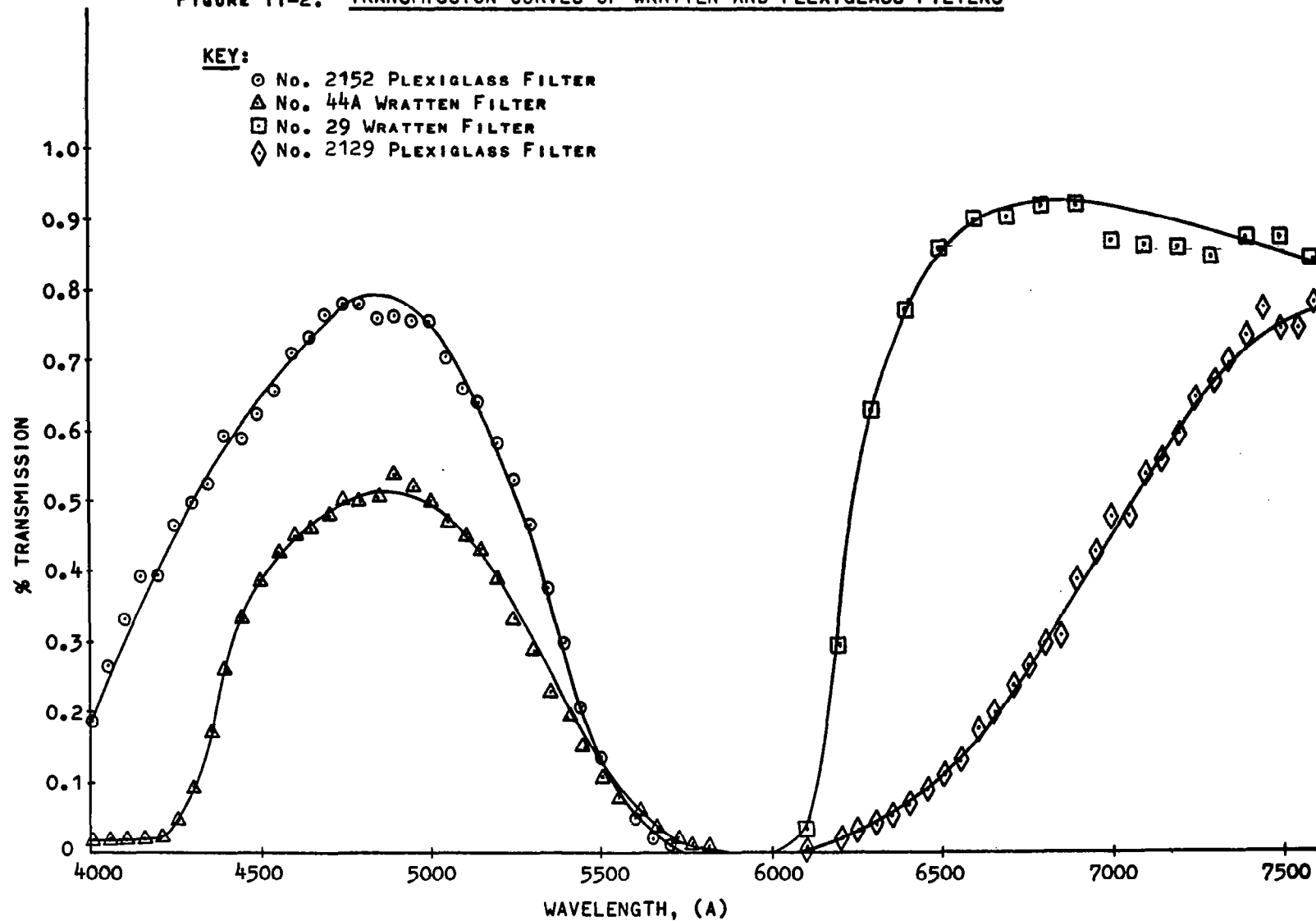VOLTAGE MULTIPLIER

FIGURE II-1. HIGH VOLTAGE POWER SUPPLY

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FIGURE II-2. TRANSMISSION CURVES OF WRATTEN AND PLEXIGLASS FILTERS

KEY:
⊙ No. 2152 PLEXIGLASS FILTER
△ No. 44A WRATTEN FILTER
▢ No. 29 WRATTEN FILTER
◇ No. 2129 PLEXIGLASS FILTER

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APPENDIX III

DETAILS OF CONFIRMED* SIGHTINGS BY TRIDENT TEAM
(Copied from Individual Reports)

A.   OBSERVATION IN ALPHONSUS ON OCTOBER 27, 1964

On the morning of October 27, 1964, E. D. Hall, Lyle T. Johnson,
and Joseph Weresiuk observed an ephemeral color phenomenon at the
base of the central peak of the crater Alphonsus. They were obser-
ving with the "Johnsonian" 16-inch reflector at Port Tobacco,
Maryland, and were utilizing the Trident Moon-Blink apparatus.
Alphonsus was first observed between 12:10 and 12:15 a.m., EST, and
appeared completely normal.

Returning to Alphonsus at 12:18 (5:18 UT), Mr. Johnson detected a
definite "blink" on the Alphonsus central peak. Professor Hall and
Mr. Weresiuk immediately confirmed the blink.

During the period from 12:18 to 12:30 a.m., the blink was observed
with the Moon-Blink equipment. The entire Ptolemaic region was
surveyed for other signs of unusual activity, but none were noted.
The rotating filter wheel was stopped and Alphonsus was viewed
briefly through alternate red and blue filters. As it was difficult
to determine the nature of the small spot by this method, it was
decided to make a direct visual observation as quickly as possible.

By 12:38 the filter wheel, image converter tube, and Barlow lens
had been removed and a 400X eyepiece put on the telescope. When
viewed with this eyepiece, a small pinkish-red spot at the base
of the sunlit portion of the central peak was observed. This ob-
servation was confirmed independently by all present and continued
until 12:45.

Since the active area was so small, it most probably would have
been overlooked had not the Moon-Blink apparatus been used.

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*Visually confirmed by qualified observers.

The sunlit wall of the small crater Lyot, on the floor of
Ptolemaeus, which was brighter than the sunlit slope of the
Alphonsus central peak, showed very narrow blue and red chro-
matic bands at opposite edges due to atmospheric dispersion.
These were later computed to be no more than one-half mile wide.
Both the red Lyot band and the Alphonsus pink region were on
the side of their respective bright areas, away from the term-
inator. The Alphonsus patch, however, was definitely wider.
Because of this difference in the size and nature of these
colored regions, and since a blink was not observed in Alphonsus
between 12:10 and 12:15 when the moon was lower in the sky,
atmospheric dispersion as the cause of the Alphonsus blink was
ruled out. The moon had also been observed on the previous
night, and although it was lower in the sky at that time, no
blink activity was noted.

There was a frequent brief doubling of the image due to seeing,
but this was in no way confused with the blink.

The sky was clear and the seeing was 5-6 with periods up to 7.
The moon rose at 10:05 and had been up for two hours and 13
minutes at the time of the first blink ovservation. The co-
longitude at that time was 167.1°.

By 1:10 the image converter tube and filter wheel had been put
back on the telescope, since no traces of color in the Alphonsus
region had been visible for nearly 25 minutes. Alphonsus
appeared quite normal, none of the three observers detecting
any further blink. Prof. Hall and Mr. Weresiuk continued ob-
serving until 3:30 a.m. without noting anything unusual. The
Alphonsus region was kept under surveillance the following
evening; no unusual activity was observed.

The following is quoted from a letter to J. J. Gilheany,
Moon-Blink Project Director, by James C. Greenacre, ACIC,
Lowell Observatory, Flagstaff, Arizona:

"You may be interested in an observation I made on the ridge
that runs south and connects with the central peak of Alphonsus.
With optimum seeing I could see that the ridge at the base of
the peak was fissured or cracked open. Also, there was at least
one small crater within the breach and very close to the base
of the peak. As far as I can determine this is the spot where
Johnson observed the blink.

"If these red spots are the result of gaseous emissions then
this spot has everything in its favor as far as topography is
concerned."

B. RECORD OF OBSERVATION -- ARISTARCHUS -- August 21, 1965

   OBSERVERS: J. J. Gilheany and J. Segerstrom

   0255 EDT: Arrived at Johnson Observatory, Port Tobacco, Mary-
               land, and found Mr. Lyle Johnson in final stage of
               preparing equipment for observations.

J. Gilheany began observing immediately, using the Moon-Blink detec-
tor. Scanned the entire lunar surface and then centered 'scope on
Aristarchus. There was a very faint blink within the crater. L.
Johnson viewed Aristarchus, and both Johnson and Gilheany doubted
the genuineness of the observation.

We then stopped observing and removed the filter wheel (which con-
sisted of Wratten 44A and Wratten 29 gelatin filters sandwiched be-
tween 1/8-inch plate glass -- the No. 29 filters were backed by 0.03
neutral density filters). We then inserted the new filter wheel,
consisting of No. 2100 (red) and No. 2152 (blue) Rohm-Haas 1/8-inch
Plexiglas, between the Barlow lens and the image tube. The quality
of the image was far better than that of any other filter wheels we
had employed. The filter wheel was being hand-held. It was well
balanced, and the background blink was insignificant. After L.
Johnson had viewed with the Plexiglas wheel, he held it in place
and Gilheany centered the 'scope on Kepler. There was a fairly sig-
nificant blink of the ray system around the crater, and luminescence
(similar to that reported by Z. Kopal) was suspected.

0355: The 'scope was then turned to Aristarchus, and Gilheany im-
mediately reported a blink within the crater. L. Johnson and J.
Segerstrom immediately confirmed the blink. The filter wheel and
image tube were removed, and L. Johnson viewed Aristarchus with a
400X eyepiece. The seeing was excellent at the time, and L. Johnson

reported that he thought he saw reddish color at the location of the blink for a fleeting moment. J. Gilheany did not observe any red coloration with the 400X eyepiece.

0405: Attempted to call RCAA at Huntsville but they did not answer. The new filter wheel and image tube were remounted, and Johnson again observed the same blink as well as an additional blink just inside the northern rim of Aristarchus. The original blink was not as pronounced as before. At this point the electrical leads to the Plexiglas filter wheel's motor parted; this experimental arrangement was removed, and the old filter wheel was again mounted. Attempts to repair motor leads were unsuccessful. No blinking was observed when using the gelatin filter wheel.

0527: Observing terminated.

The following report of the same event was submitted independently by Lyle T. Johnson, owner of the Port Tobacco Observatory.

BLINK OBSERVED IN ARISTARCHUS -- August 21, 1965

On the night of August 20-21, 1965, Mr. Gilheany, Mr. Segerstrom, and I were observing the Moon, using Moon-Blink equipment.

Observing began at 2:55 AM EDT using a filter wheel of gelatin filters sandwiched between glass and placed ahead of the Barlow lens. A blink was suspected in Aristarchus but we could not be sure it was genuine. After scanning the Moon the filter wheel was removed and a new plastic wheel was tried between the Barlow lens and the image tube. It was found that definition was greatly improved with the new wheel.

At 3:35 there was a definite blink in Aristarchus (the same area where one had been suspected before). The blink covered most of

the southwest (IAU directions) inner slope of Aristarchus crater wall, an area of roughly 10 by 5 miles as measured on U. S. Air Force chart LAC 39.

The Moon-Blink equipment and the Barlow lens were removed and a 400X eyepiece put on the telescope. Seeing was excellent at times, once for about 15 seconds straight. The terraces were viewed better than I remember ever seeing them. There was a moment when I suspected a very slight reddish color in the area of the blink but I could not be at all sure of it. It may have been due to atmospheric dispersion.

4:05 -- The eyepiece was removed, Barlow replaced and the new filter wheel again used. The blink was not as pronounced as before but a small area just inside the northern rim of Aristarchus was now also blinking. This was not an intense blink but was definite, and apparently short-lived. This area was not more than two miles across and seemed to be roughly triangular in shape.

Sketch by L. Johnson at about 3:35 using Moon - Blink Reflector. (Blink in dotted area.)

The blinks observed in Aristarchus were much less intense (less contrast) than the blink observed in Alphonsus in October 1964.

Observations were interrupted when a wire on the motor for the new filter wheel broke and the old filter wheel was put back on. Definition was then not as good when using the plastic wheel.

C. SEQUENCE OF EVENTS OF SIGHTING IN ARISTARCHUS (47° E, 23° N)
AT PORT TOBACCO, NOVEMBER 14-15, 1965

Professors E. D. Hall and D. A. Nordling (physicists, U. S. Naval
Academy) were the two Trident "Moon-Blink" team members scheduled
to observe at the Johnson Observatory, Port Tobacco, Maryland, on
the night of November 14-15. They arrived promptly, set up the
equipment, and actually began observing at 10 minutes past mid-
night, Eastern Standard Time. The Trident-developed "Moon-Blink"
apparatus was, as usual, installed for this routine surveillance
program.

The seeing was rather poor at this time, the moon quite low (esti-
mated at 30°). The moon was just entering its 3rd Quarter -- age
21 days -- 62% of the disc visible. The central peak of Aristar-
chus was about 62° from the terminator.

Alphonsus was viewed first, with no sign of any unusual activity
being noted; and the same was true of Aristarchus, which was
checked at about 0015. During the next half hour a routine, system-
atic search of the entire lunar surface was made. Particular attention
was given to the Alphonsus and Aristarchus regions, but still no
unusual activity was noted anywhere.

Then, at 0055 E. Hall, while viewing the Aristarchus region,
thought he detected a slight blink in the central region of the
crater Aristarchus. He checked the surrounding area carefully but
saw no other unusual areas. Without mentioning a specific area,
he asked D. Nordling to view -- who almost immediately confirmed
the possibility of a blink.

At 0110, although the activity still persisted, the decision was

made not to alert the confirmation telephone network because of the marginal seeing conditions. However, as a precautionary measure, it was decided to remove the blink apparatus and take a sequence of 36 photographs of the suspected area. Accordingly, the Nikon-F camera on hand for this purpose was used in taking 12 exposures through a red (Wratten No. 29) filter, 12 through a blue (Wratten No. 44A) filter, and 12 with no filter. The lens opening was set at f1.4, and Tri-X black and white film was used.

When the blink unit was reinstalled, at 0120, Hall and Nordling noted that the blink activity still persisted. It was, in fact, more pronounced than before, a fact which could be at least partly attributed to the improvement in seeing conditions as the moon rose.

Lyle Johnson, owner of the 16-inch telescope and observatory, was called and upon his arrival (at 0130) observed Aristarchus. He immediately slowed the speed of the revolving filter wheel. (This had also been done earlier by the two Trident observers.) When the blink frequency was found to be dependent upon the speed of the filter wheel and when a careful surveillance of the area revealed no other unusual activity, Mr. Johnson confirmed the blink. There was at this time no doubt in the three observers' minds that they were witnessing an ephemeral color event.

The NASA confirmation conference call to 16 observatories in the eastern United States was initiated at 0135 in accordance with the procedure established by Mrs. W. Cameron of Goddard Space Flight Center. Within an estimated ten minutes, the conference call telephone operator had received responses from at least the following six observatories. (The comments indicated were obtained the following day during a "debriefing" check.)

Observational Group & Location

Fels Planetarium, Philadelphia, Pa.	Saw unusual "cloudiness" in exact spot -- mailed in report to GSFC.
Goddard Optical System, Greenbelt, Md.	Saw red color in Aristarchus with 4-inch telescope, but saw nothing with the 16-inch.
Goddard Radio Telescope at Rosman, N. C.	Obtained radio data -- compared with the following night (non-event), record showed nothing abnormal for the event.
Allegheny Observatory, Pittsburgh, Pa.	Could not check because of special equipment mounted.
U. S. Naval Observatory, Washington, D. C.	Could not check because of special equipment mounted.
Arthur J. Dyer Observatory, Nashville, Tenn.	Checked, but too cloudy to see.
AAVSO, Mountainside, N. J.	Saw nothing unusual.

Meanwhile, Hall, Johnson, and Nordling continued observing alternately, using the "Moon-Blinker." They made an extensive effort to find other lunar features illuminated similarly to Aristarchus that might be exhibiting any unusual tendencies. The crater Alphonsus was also repeatedly and carefully checked. No activity was noted in any other area.

At 0145 the "Moon-Blink" equipment was removed from the telescope and D. Nordling used the same Nikon-F camera to take a 20-exposure roll of color film -- Kodak High Speed Ektachrome, Daylight Type. When the blink apparatus was reinstalled, all three observers independently confirmed that the activity still persisted. Then -- at 0200 -- the "Moon-Blinker" was again replaced and the persistence of the blink again confirmed independently by the three observers. By this time (0200-0230) the seeing conditions had steadily improved

and could now be rated as "good" -- while the blink activity was even more pronounced than before.

At 0225 the Nikon was reinstalled on the telescope and a second 36-exposure sequence of black and white photographs was taken using 35mm Tri-X film.

Except for the ten-minute intervals to make these photographic sequences, the "Moon-Blinker" was used continuously during the period between 0235 and 0500 to confirm the presence of the blink in Aristarchus, to check on the Alphonsus area, and to search for any other lunar feature with illumination similar to that of Aristarchus which might show a blink. This was important because the absence of any other blink activity was an excellent indication that the activity in the Aristarchus area represented, in fact, an actual ephemeral color event.

During the time that this blink was under observation, the activity appeared to "fade" for perhaps 30-second intervals -- but it always reappeared and its regularity ruled out atmospheric anomalies in its origins. Johnson retired from the observatory at 0315, while Hall and Nordling continued observing alternately.

From 0500 to 0525 the activity became markedly less pronounced, as verified by both observers; and by 0525 both had doubts as to whether it was in fact actually present. It would appear rather distinct at times, then fade almost to nothing. This was not attributed to seeing. Inasmuch as nautical twilight was listed as due to commence at 0548 on this date, Hall and Nordling decided to try for a "reference no-blink" sequence of photographs of the Aristarchus area at 0525. The "Moon-Blinker" was replaced after taking this last roll of black and white film. When Mr. Johnson returned to the telescope

at about 0545, he agreed it was difficult to determine definitely whether an activity still existed. The seeing deteriorated rapidly from 0548 on, and at 0600 the three observers decided that further observations were useless.

Visual judgment led to the belief that the activity was brightest when viewed through the blue portion of the filter wheel, seeming to indicate that the event might consist of an enhancement in the blue portion of the spectrum.

APPENDIX IV

PHOTOGRAPHIC TECHNIQUE

There are many ways in which we can record the moon's surface
photographically. In using the Johnson telescope at Port Tobacco,
Trident found the best method was to photograph the image formed
by the elliptical mirror. This image is located about one inch
beyond the base plate which normally holds the Barlow lens. The
diameter of the moon's image at this point is approximately 2.16
inches.

Equipment and Assembly

For this purpose we have acquired two 35mm single lens reflex
cameras (a Minolta SR-1B and a Nikon) and a set of extension
tubes. The Nikon camera is shown in Figure IV-1. The image
tube and the Barlow lens must be removed from the telescope
when using the camera, and the camera mount will be found bolted
to the underside of the arm which was used to mount the image
tube. The focusing rack will then be mounted on the camera mount.
Before the camera is mounted on the focusing rack, the exten-
sion tubes, etc. should be mounted on the camera. To avoid
having the camera lens lying loose on the table while the nec-
essary equipment is mounted on the camera, we found it best to
build from the front of the lens with the lens still in the
camera.

With the camera lens in its normal position on the camera body, the
operator screws the Series 7 adapter ring to the front of the lens.
The reverse adapter should be screwed into the Series 7 adapter
ring. The desired extension tubes should be assembled and screwed
into the reverse adapter. The T-adapter is then screwed to the
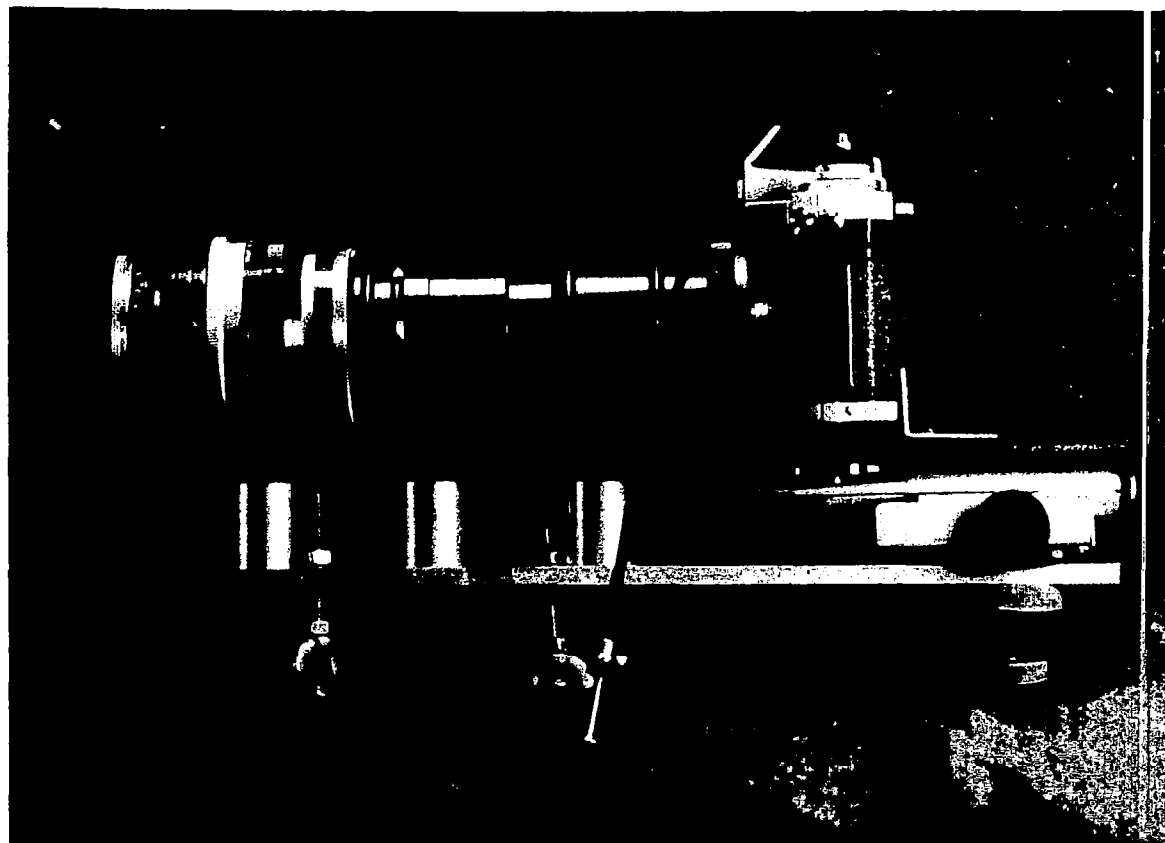
Figure IV-1. Nikon Camera Modified for Use on the Johnson Telescope

extension tube assembly. The camera lens and assembly are removed
from the camera body, turned around, and attached to the camera
body by means of the T-adapter. The Series 7 slip-on ring is
attached to the rear of the camera lens. The camera and assembly
are mounted to the focusing rack.

Exposure

We recommend that a cable release be used at all times for picture
taking through the telescope.

It is important to assure that each observer becomes familiar with
the operation of the cameras, and most camera instruction manuals
cover this purpose adequately. It should be pointed out that the
automatic diaphragm mechanism will not be operative while the lens
is in the reversed position. The desired aperture must be manually
set by the operator. It is advised that the maximum aperture
(f/1.8) be used for all exposures. Later on, if greater resolution
is desired, smaller apertures may be attempted. To record the
blink phenomenon, it is essential to make a photograph using a red
filter and another photograph using a blue filter. For this pur-
pose, red and blue filters have been cut to the proper size and
each put between two Series 7 retaining rings so that they will
screw into the slip-on ring. The lens shade may be screwed into
the filter-retaining-ring set.

To make exposures of longer duration than 1 second, the camera
shutter speed control will have to be set on "B". With a cover
over the lens (such as a piece of light cardboard), the shutter is
opened and held open by means of the set screw on the cable release.
The cardboard is quickly removed for the desired exposure and then
replaced. It should be pointed out that VIBRATION is a serious

problem, so that extreme care should be used in removing the cardboard cover.

Because of the fact that the exposure for the moon will vary from one phase to another, no exact exposure can be established, and it is advised that exposure be bracketed around a proposed exposure time. For example, if the proposed exposure time is two seconds, it is suggested that exposures be made at 1/2 second, 1 second, 2 seconds, 4 seconds, and 8 seconds. It should be noted that successive exposure times are doubled. If red and blue filter exposures are to be made, it is suggested that -- after a red filter exposure is made -- the corresponding blue filter exposure should be made so that the exposures will appear adjacent to each other on the film. If a series of no filter, red filter, blue filter exposures is to be made, these should be made in groups of three so that the corresponding exposures will appear adjacent to each other on the film. The proposed exposure can be obtained by referring to Table IV-1 and Table IV-2. The former table also contains some useful information on desired effect and physical distances involved.

. The following information should accompany each roll of exposed film returned for processing:

    A. The date and approximate time the picture was made.

    B. The roll number. (Each roll of film will be numbered sequentially -- 1, 2, 3, ... etc., for each observing session.)

    C. The frame number.

    D. The type of film used.

    E. The extension tubes used.

    F. Identification of the portion of the moon which was photographed.

TABLE No. IV-1. EXPOSURE FACTORS

DIAMETER OF MOON IMAGE	AREA RATIO COVERED BY FILM VERSUS MOON IMAGE	COMPONENTS USED (A)(B)(G) (H)(I)(J)+	DISTANCE FROM TELESCOPE IMAGE TO BACK OF CAMERA	DISTANCE FROM TELESCOPE IMAGE TO FRONT OF LENS	APPROXIMATE EXPOSURE FACTORS (SEE TABLE No. IV-2)		
(CM/IN)	(-)	(-)	(CM/IN)	(CM/IN)	NO FILTER	RED #29	BLUE #44A
4.16/1.64	0.635		22.82/8.99	10.23/4.03	(32)	(23)	(26)
5.06/1.99	0.430	(c)	22.62/8.90	9.18/3.62	(30)	(21)	(24)
6.05/2.38	0.302	(D)	22.47/8.85	8.08/3.18	(29)	(20)	(23)
7.00/2.76	0.225	(E)	22.70/8.95	7.37/2.90	(28)	(19)	(22)
7.98/3.14	0.173	(c)(E)	23.16/9.12	6.88/2.71	(26)	(17)	(20)
8.30/3.27	0.160	(F) **	23.33/9.18	6.73/2.65	(26)	(17)	(20)
9.85/3.88	0.114	(F) *	24.33/9.55	6.09/2.40	(25)	(16)	(19)
9.20/3.62	0.130	(c)(F) **	23.90/9.45	6.35/2.50	(26)	(17)	(20)
10.8/4.26	0.0945	(c)(F) *	25.01/9.85	5.82/2.30	(25)	(16)	(19)
10.2/4.02	0.106	(D)(F) **	24.56/9.65	6.06/2.38	(25)	(16)	(19)
11.7/4.61	0.0809	(D)(F) *	25.73/10.1	5.59/2.20	(24)	(15)	(18)
11.1/4.37	0.0895	(E)(F) **	25.27/9.95	4.73/1.86	(24)	(15)	(18)
12.7/5.00	0.0681	(E)(F) *	26.50/10.45	5.42/2.14	(23)	(14)	(17)
12.1/4.77	0.0752	(c)(E)(F)**	25/98/10.3	5.59/2.20	(24)	(15)	(18)
13.6/5.37	0.0595	(c)(E)(F)*	27.26/10.75	5.26/2.07	(23)	(14)	(17)
13.1/5.17	0.0640	(D)(E)(F)**	26.73/10.5	5.39/2.13	(23)	(14)	(17)
14.6/5.75	0.0518	(D)(E)(F)*	28.06/11.1	5.08/2.00	(22)	(13)	(16)
13.9/5.48	0.0569	(c)(D)(E) (F) **	27.55/10.9	5.26/2.07	(23)	(14)	(17)
15.6/6.15	0.0452	(c)(D)(E) (F) *	28.90/11.4	4.97/1.96	(22)	(13)	(16)

*WITH THE VARIABLE EXTENSION (F) IN MAXIMUM EXTENSION
**WITH THE VARIABLE EXTENSION (F) IN MINIMUM EXTENSION

Table No. IV-2. Exposure (Seconds)

ASA Speed	10	12	16	20	25	32	40	50	64	80	100	125	160	200	250	320	400	500	650	800
(1)	850	640	512	400	320	256	200	160	128	100	80	64	50	40	32	25	20	16	13	10
(2)	640	512	400	320	256	200	160	128	100	80	64	50	40	32	25	20	16	13	10	8
(3)	512	400	320	256	200	160	128	100	80	64	50	40	32	25	20	16	13	10	8	6
(4)	400	320	256	200	160	128	100	80	64	50	40	32	25	20	16	13	10	8	6	5
(5)	320	256	200	160	128	100	80	64	50	40	32	25	20	16	13	10	8	6	5	4
(6)	256	200	160	128	100	80	64	50	40	32	25	20	16	13	10	8	6	5	4	3
(7)	200	160	128	100	80	64	50	40	32	25	20	16	13	10	8	6	5	4	3	$2\frac{1}{2}$
(8)	160	128	100	80	64	50	40	32	25	20	16	13	10	8	6	5	4	3	$2\frac{1}{2}$	2
(9)	128	100	80	64	50	40	32	25	20	16	13	10	8	6	5	4	3	$2\frac{1}{2}$	2	$1\frac{1}{2}$
(10)	100	80	64	50	40	32	25	20	16	13	10	8	6	5	4	3	$2\frac{1}{2}$	2	$1\frac{1}{2}$	$1\frac{1}{4}$
(11)	80	64	50	40	32	25	20	16	13	10	8	6	5	4	3	$2\frac{1}{2}$	2	$1\frac{1}{2}$	$1\frac{1}{4}$	1
(12)	64	50	40	32	25	20	16	13	10	8	6	5	4	3	$2\frac{1}{2}$	2	$1\frac{1}{2}$	$1\frac{1}{4}$	1	4/5
(13)	50	40	32	25	20	16	13	10	8	6	5	4	3	$2\frac{1}{2}$	2	$1\frac{1}{2}$	$1\frac{1}{4}$	1	4/5	2/3
(14)	40	32	25	20	16	13	10	8	6	5	4	3	$2\frac{1}{2}$	2	$1\frac{1}{2}$	$1\frac{1}{4}$	1	4/5	2/3	1/2
(15)	32	25	20	16	13	10	8	6	5	4	3	$2\frac{1}{2}$	2	$1\frac{1}{2}$	$1\frac{1}{4}$	1	4/5	2/3	1/2	2/5
(16)	25	20	16	13	10	8	6	5	4	3	$2\frac{1}{2}$	2	$1\frac{1}{2}$	$1\frac{1}{4}$	1	4/5	2/3	1/2	2/5	1/3
(17)	20	16	13	10	8	6	5	4	3	$2\frac{1}{2}$	2	$1\frac{1}{2}$	$1\frac{1}{4}$	1	4/5	2/3	1/2	2/5	1/3	1/4
(18)	16	13	10	8	6	5	4	3	$2\frac{1}{2}$	2	$1\frac{1}{2}$	$1\frac{1}{4}$	1	4/5	2/3	1/2	2/5	1/3	1/4	1/5
(19)	13	10	8	6	5	4	3	$2\frac{1}{2}$	2	$1\frac{1}{2}$	$1\frac{1}{4}$	1	4/5	2/3	1/2	2/5	1/3	1/4	1/5	1/6
(20)	10	8	6	5	4	3	$2\frac{1}{2}$	2	$1\frac{1}{2}$	$1\frac{1}{4}$	1	4/5	2/3	1/2	2/5	1/3	1/4	1/5	1/6	1/8
(21)	8	6	5	4	3	$2\frac{1}{2}$	2	$1\frac{1}{2}$	$1\frac{1}{4}$	1	4/5	2/3	1/2	2/5	1/3	1/4	1/5	1/6	1/8	1/10
(22)	6	5	4	3	$2\frac{1}{2}$	2	$1\frac{1}{2}$	$1\frac{1}{4}$	1	4/5	2/3	1/2	2/5	1/3	1/4	1/5	1/6	1/8	1/10	1/12
(23)	5	4	3	$2\frac{1}{2}$	2	$1\frac{1}{2}$	$1\frac{1}{4}$	1	4/5	2/3	1/2	2/5	1/3	1/4	1/5	1/6	1/8	1/10	1/12	1/15
(24)	4	3	$2\frac{1}{2}$	2	$1\frac{1}{2}$	$1\frac{1}{4}$	1	4/5	2/3	1/2	2/5	1/3	1/4	1/5	1/6	1/8	1/10	1/12	1/15	1/20
(25)	3	$2\frac{1}{2}$	2	$1\frac{1}{2}$	$1\frac{1}{4}$	1	4/5	2/3	1/2	2/5	1/3	1/4	1/5	1/6	1/8	1/10	1/12	1/15	1/20	1/25
(26)	$2\frac{1}{2}$	2	$1\frac{1}{2}$	$1\frac{1}{4}$	1	4/5	2/3	1/2	2/5	1/3	1/4	1/5	1/6	1/8	1/10	1/12	1/15	1/20	1/25	1/30
(27)	2	$1\frac{1}{2}$	$1\frac{1}{4}$	1	4/5	2/3	1/2	2/5	1/3	1/4	1/5	1/6	1/8	1/10	1/12	1/15	1/20	1/25	1/30	1/40
(28)	$1\frac{1}{2}$	$1\frac{1}{4}$	1	4/5	2/3	1/2	2/5	1/3	1/4	1/5	1/6	1/8	1/10	1/12	1/15	1/20	1/25	1/30	1/40	1/50
(29)	$1\frac{1}{4}$	1	4/5	2/3	1/2	2/5	1/3	1/4	1/5	1/6	1/8	1/10	1/12	1/15	1/20	1/25	1/30	1/40	1/50	1/60
(30)	1	4/5	2/3	1/2	2/5	1/3	1/4	1/5	1/6	1/8	1/10	1/12	1/15	1/20	1/25	1/30	1/40	1/50	1/60	1/80

G. Type of filter used.

H. The exposure time.

I. The f-number on the camera lens which was used.

J. A statement as to the observer's judgment about the condition of the atmosphere (for photographic purposes) .

K. Any other comments which might be pertinent.

When Photographs Should be Made

Of course, if any activity or suspected activity is observed, it should be photographed. It is suggested that at least one roll of film be used for photographing particular regions of interest on the moon's surface every observing night for a sufficiently long period to insure that the results are consistently good with every observer and under all conditions to be expected.

Because a mount large enough to enable the observer to photograph either the primary image of the telescope or the face of the image tube would necessitate drilling several mounting holes in the end casting of the Johnson telescope, this capability has been delayed. In order to avoid making permanent modification to this telescope, Trident planned to procure a replacement end casting which would permit installation of the more flexible camera mount, the multi-purpose detector mount, and the image orthicon mount.

APPENDIX V

PHOTOGRAPHIC FILM-DEVELOPMENT TECHNIQUE

The film used for black and white photography of the moon is Kodak
Tri-X Panchromatic film. The color film used is Kodak High Speed
Ektrachrome.

The development of the black and white film makes use of an Ansco-
matic daylight development tank (16-ounce capacity). The developer
used is Kodak D 76. Figure V-1 is a graph showing the time of devel-
opment vs temperature to produce a gamma of 1.3. Figure V-2 is
a graph showing the H & D curve for the development used.

After the developing tank has been loaded, the development techni-
que is as follows:

A.   Check the temperature of the developer and the hypo making
     sure they are at about 68°F and within 1°F of each other.

B.   Prepare a temperature bath for the developer tank. The
     temperature of the bath should be within ½°F of the temper-
     ature of the developer. Rinse water (32-ounces) to be used
     between development and fixing must be made available. The
     temperature must be within 1°F of the temperature of the
     developer.

C.   Note the time of development (see figure 4). The time
     for filling and emptying the developing tank must be ac-
     counted for. It takes 25 seconds to fill or empty the
     Anscomatic developing tank.

D.   Development is accomplished by first loading the tank with
     developer (timing begins after the tank is loaded). Give
     the tank a sharp rap to break air bubbles from the film and
     agitate continuously for the first 30 seconds. Agitation
     continues 5 seconds out of every 30 seconds thereafter.

E.   Begin emptying the tank of developer 25 seconds before
     development time is up. The tank is filled and emptied with
     rinse water twice during the 1 minute and them filled with
     hypo for fixing.

F.   The film should be fixed for 10 minutes. Agitate contin-
     uously for the first minute of fixing and occasionally

throughout fixing.

G. Wash the film for 30 minutes in running water at a temperature which is within 2°F of the temperature of the solutions. Kodak Hypo Cleaning Agent may be used to reduce the washing time.

H. The film is next hung to dry. (The drying time depends on local humidity and temperature.)

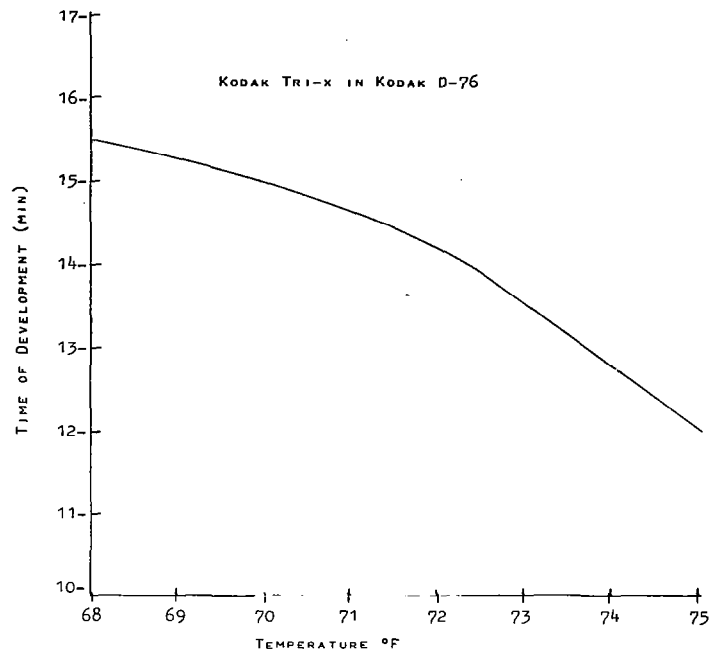The color film is processed according to Kodak's recommendation using Kodak E-2 processing.

KODAK TRI-X IN KODAK D-76

FIGURE V-1. TIME OF DEVELOPMENT VERSUS TEMPERATURE

H & D CURVE
KODAK TRI-X PAN
DEVELOPED IN D-76
14.5 MIN 71°F
GAMMA = 1.3
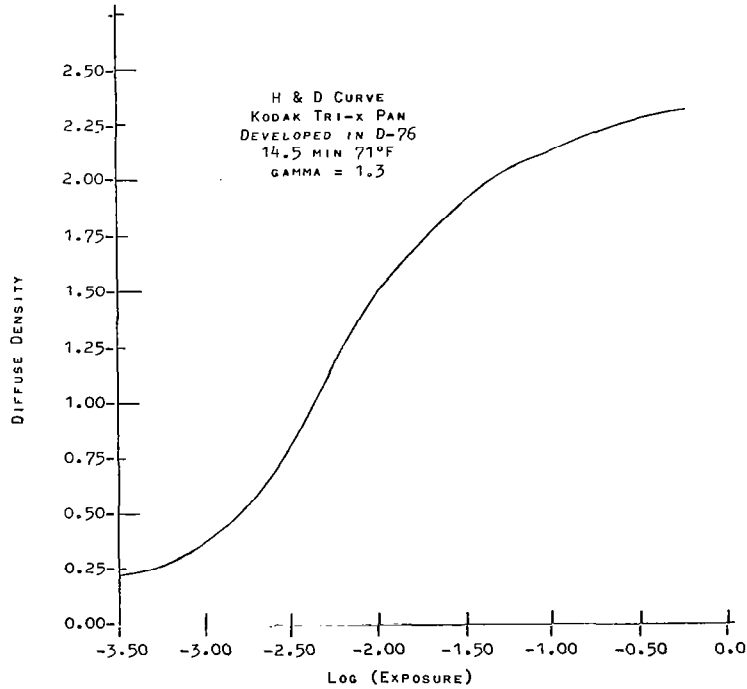
FIGURE V-2. H & D CURVE FOR DEVELOPMENT USED

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APPENDIX VI

FUNCTIONAL DESCRIPTION OF SPECTROGRAPHIC EQUIPMENT

The combination of a practical time and financial consideration imposed on the design was not compatible with grating type instruments. Consequently, laboratory feasibility studies were limited to various prism configurations.

Extensive optical bench mock-ups indicated that the limitations imposed on the design could best be satisfied by the utilization of a direct vision prism instrument.

A direct vision prism commercially available from Leybold was obtained and, after laboratory tests, this prism was selected for the prototype spectrograph. This direct vision prism is composed of a three-prism train. It has a cross sectional area of 20 x 20 mm^2 and a length of 102mm. The angular dispersion between the hydrogen C and F lines (6562.8A and 4861.3A respectively) is 4°14', resulting in a linear dispersion of about 100A/mm.

The film mounting and shutter was a Miranda single lens reflex camera back, chosen because of its embodiment of a focal plane shutter.

Two aluminized needles act as a reflecting slit and enable the viewer to accurately position the slit while viewing the lunar surface with the image converter tube.

Two coated achromatic lenses (diameter = 25mm; focal length = 122mm) are utilized as indicated in Figure VI-1.

The slit needle is located in the focal plane of lens L_1. Parallel light incident upon the prism is, after refraction, imaged by lens L_2 on the film which is located in the focal plane of L_2.

Physical support is given the optical elements by suitable standard 35mm extension tubes.

Exact focusing is achieved by using a Spiratone bellows located as shown in the diagram. The entire spectrograph is rack and pinion mounted for accurate positioning of the slit on the image of the lunar disc.

The length of the spectrum between 4000A and 7000A is 27mm. The Hg yellow lines (5770A and 5790A) are separated by 0.15mm, yielding a dispersion of 110A/mm for the former and 120A/mm for the latter.

Kodak Tri-X 35mm film has been used, and an exposure time of ten minutes is satisfactory under a rather wide variety of viewing conditions.

A photograph of the completed spectrograph is included as Figure VI-2.
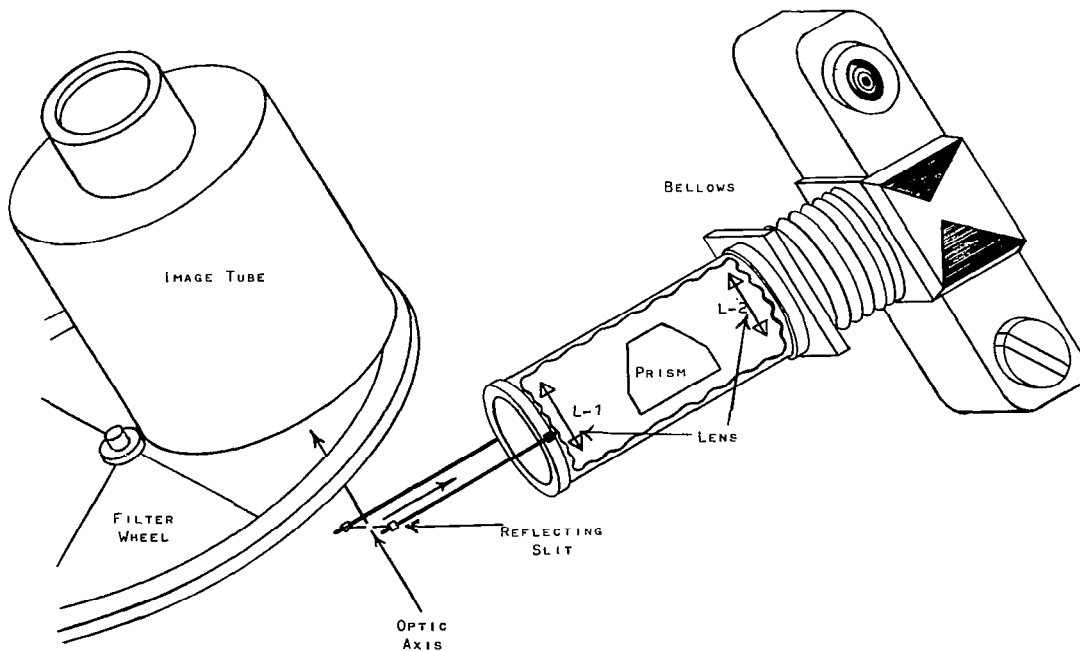
FIGURE VI-1. SKETCH OF MOON-BLINK SPECTROSCOPE

Figure VI-2. Photograph of Moon-Blink Spectroscope

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APPENDIX VII

FUNCTIONAL DESCRIPTION OF INFRARED TECHNIQUE

As presently envisioned, the IR technique to be utilized in the
multi-purpose detector would consist of a two-channel thermocouple.
Each of the two thermocouples should be in a high vacuum environ-
ment -- one unit to be thermally shielded and the other tube
exposed through a potassium bromide (KBr) window to the lunar
radiation through the telescope. Since the thermocouple would
be located at the prime focus of the 16-inch reflecting telescope,
the infrared radiation would be required to pass through only the
earth's atmosphere, which is transparent to wavelengths of 8 to 9.7
microns and 10 to 12.7 microns, and through the KBr window of the
detector, which is transparent to wavelengths of 0.23 to 27
microns. Since the maximum radiant emittance varies with temper-
ature from 8 microns at 400°K to 25 microns at 100°K, radiant
energy from the lunar surface should be detectable through the
earth's atmosphere.

In general, the output of the shielded thermocouple can be thought
of as representing the thermal energy reaching the detecting
elements due to ambient temperature of the observatory. The output
of the thermocouple behind the window would be a measure of
ambient energy plus any additional energy received via the tele-
scope. A comparison of the two outputs would be an indication of
infrared radiation from the moon.

By causing the telescope to scan the lunar surface, a comparison
of infrared radiation from different points on the surface   --
in particular, between the general surface and the region of red
coloration -- could be made.

The switching gate (shown in Figure VII-1) would alternately
sample the two thermocouple outputs and compare them in such a

manner that the composite output of the gate would be proportional
to the difference between the two thermocouple signals and would
be a square wave with the frequency of the sampling rate. This
square wave temperature signal would be amplified and measured by
the microvolt meter. The initial intent would be to obtain rela-
tive measurements only. However, an absolute calibration could be
achieved if desired.

The microvolt meter has an output circuit that allows the signal
to be applied to a graphic recorder, yielding a permanent record
of measurements.

The major equipment for the infrared phase has been procured
under the present contract and is on hand. This includes
   A. Dual Thermocouple -- A Hilger-Schwarz type Ft 16.1 thermo-
       pile with a sensitivity of 26 microvolts per microwatt and
       a potassium bromide window on the unshielded element.
   B. AC Amplifier -- A Keithley Instruments Model 103 ac amplifier
       with a gain of 1000 and a sensitivity o 0.3 microvolt.
   C. Power Supply -- A Keithley Instruments Model 1031 ac power
       supply for the model 103 ac amplifier.
   D. Microvoltmeter -- A Keithley Instruments Model 150A micro-
       volt Ammeter, with 13 ranges from one microvolt to one
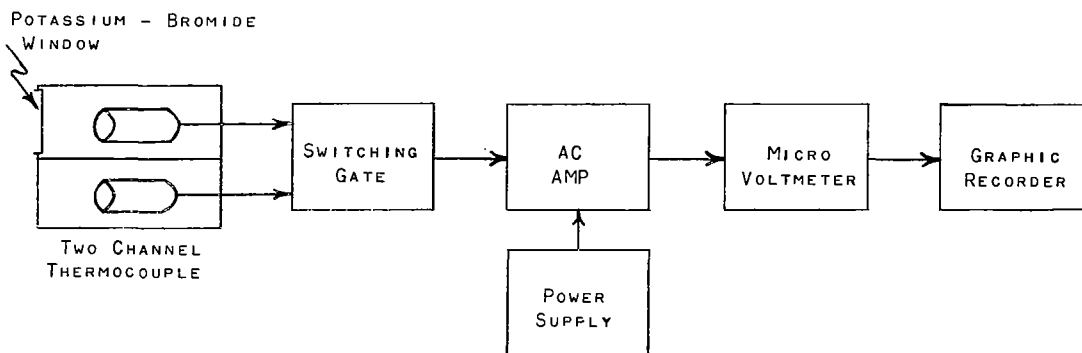   volt.

FIGURE VII-1.   BLOCK DIAGRAM OF INFRARED DETECTOR

APPENDIX VIII

FUNCTIONAL DESCRIPTION OF PROPOSED TV INSTALLATION

The proposed TV installation will consist of a modified commercial field chain. Specifically, an RCA TK31 is recommended.

The image tube and deflection coils will be removed from the TK31 camera unit and then mounted on the telescope. This would considerably reduce the bulk and weight to be placed on the telescope.

The video signal from the image orthicon is too low a level to be sent from the telescope to the camera control unit six to ten feet away. Therefore, a video amplifier will be installed on the telescope.

The camera control unit and the local monitor would both be installed in the observatory. A large remote monitor and a small five-inch photographic monitor would be installed in the equipment van. The photographic monitor would have a large magazine 35mm camera attached in such a manner that it can, at will, be made to photograph the television image. The camera would be electrically driven so that exposures can be taken of each television frame or of various multiples of several frames.

Since the filter wheel would have to revolve in synchronism with the 30-per-second frame rate of the television system, the current practice of using a small, variable speed dc motor to drive the filter wheel would no longer be adequate. A sixty-cycle hysteresis motor has a speed that is very closely controlled by the frequency of the voltage applied. The frame rate of the television system is also controlled by line voltage frequency. Therefore, such a motor would remain in step with the television. However, such motors are rather large and heavy. Also, the gear trains required to permit a selection of various speeds would add bulk and

weight to the telescope. Even if bulk and weight were acceptable, such a direct drive would not allow remote control of motor speed.

For these reasons, it is proposed that a 60-cycle hysteresis motor and gear train to allow speeds of 60, 90, 180, 450 rpm be located in the equipment van. The output of the selected gear train would drive a 400-cycle synchro transmitter. The transmitter would electrically drive a differential transformer which would, in turn, electrically drive a 600-cycle synchro motor mounted on the telescope.

The mechanical differential input would allow fine adjustment while the filter wheel is running to insure that the change from red to blue filter would occur at precisely the start of the appropriate video frame. Also, with the 60-cycle drive motor turned off, the differential input would allow remote manual positioning of the filter wheel.

Although not shown on Figure VII-1, remote controls for positioning the telescope would be located in the equipment van.
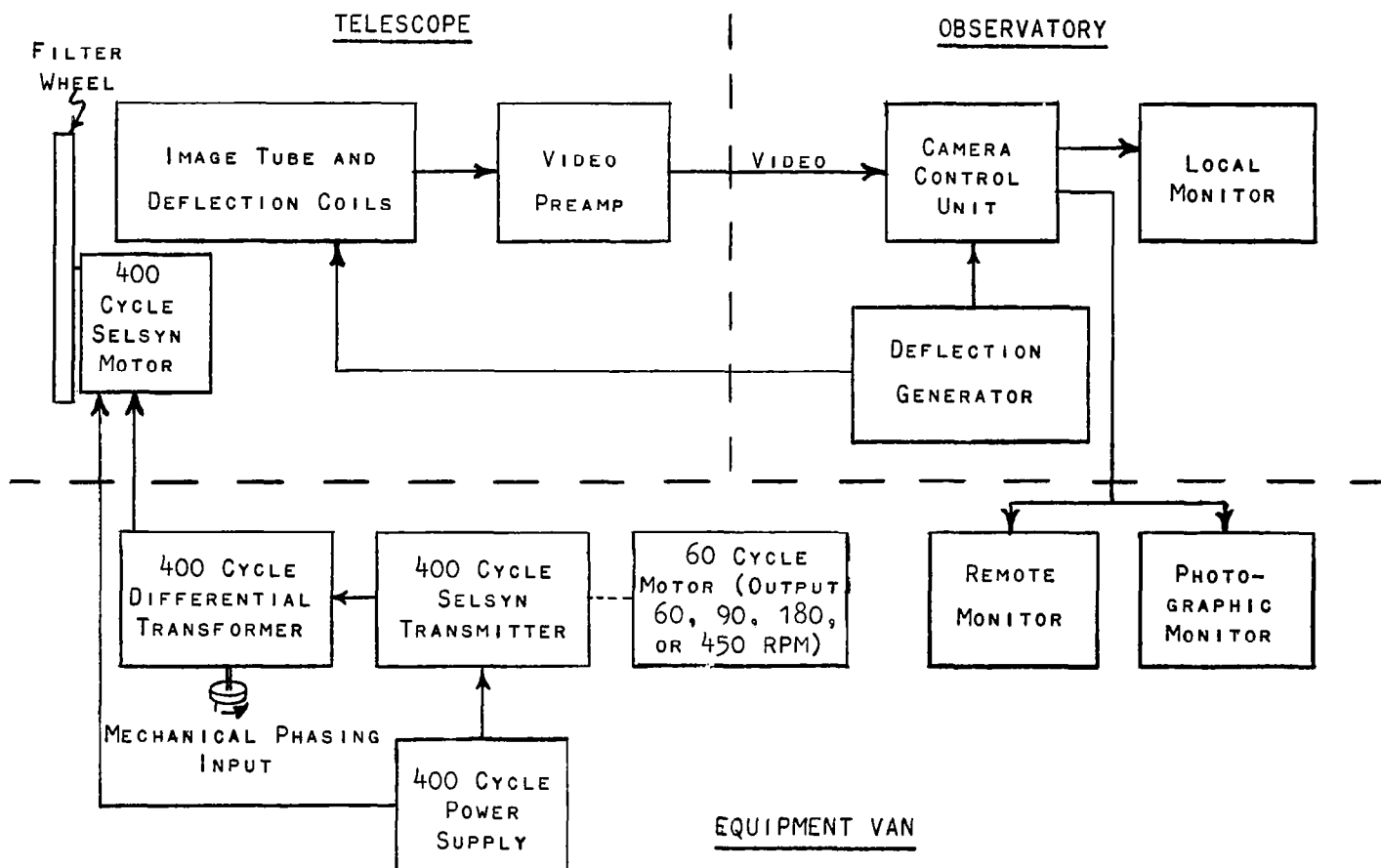
FIGURE VIII-1. BLOCK DIAGRAM OF TV INSTALLATION

APPENDIX IX

FUNCTIONAL DESCRIPTION OF PROPOSED AUTOMATIC DETECTOR

The proposed automatic detector would utilize the previously
discussed image orthicon TV installation on the Johnson 16-inch
telescope at Port Tobacco, Maryland.

The image tube installation on the telescope would not be changed,
but the video preamp would feel two gated video amplifiers. The
gating signals would be derived from the rotating filter wheel in
such a way that one amplifier would operate when the red filter
was in the optic train and the other would operate when the blue
filter was in the optic train.

Individual controls on these two amplifiers would then allow
individual adjustment of brightness and contrast of the red and
blue images. With the remote switch in the "A" position, these
two signals are recombined in the buffer and fed to the camera
control unit and all monitors. This would result in a conventional
Moon-Blink presentation with the added advantage that all back-
ground blink would be eliminated electronically.

The output of the blue gated video amplifier is fed through a
phase shifter which exactly inverts the image, making it essentially
a negative. These two signals (the positive red and negative
blue) are fed to the integrator. Over a period of time, the output
of the integrator would be zero if the red and blue images were
identical. If, however, a red coloration should occur on the lunar
surface, it would appear on the red image but not on the blue
image. The integrator would then have a net positive output,
activating the alarm, starting the 35mm camera and the video tape
recorder.

Placing the remote control video switch in the B position has
no effect on the integrator but would feed the negative blue

signal to the buffer instead of the positive blue signal. The effect of feeding the combined positive red signal and negative blue signal to the camera control unit would, as seen on the monitors, be such that the two signals would cancel each other unless a red phenomenon occured, at which time only the red phenomenon would appear on the monitor.

The signals from the wheel sensor would also feed color indicators on the monitors and the tape recorder in such a way that the color of filter associated with a particular video presentation could always be determined.

The color indicator on the camera monitor would also trigger the camera so that alternate pictures would be taken of red and blue images.

Although not shown on Figures IX-1 and IX-2, the equipment van would, of course, have provisions for remotely positioning the telescope, operating the video switch, and adjusting the gain and contrast on the gated video amplifiers.
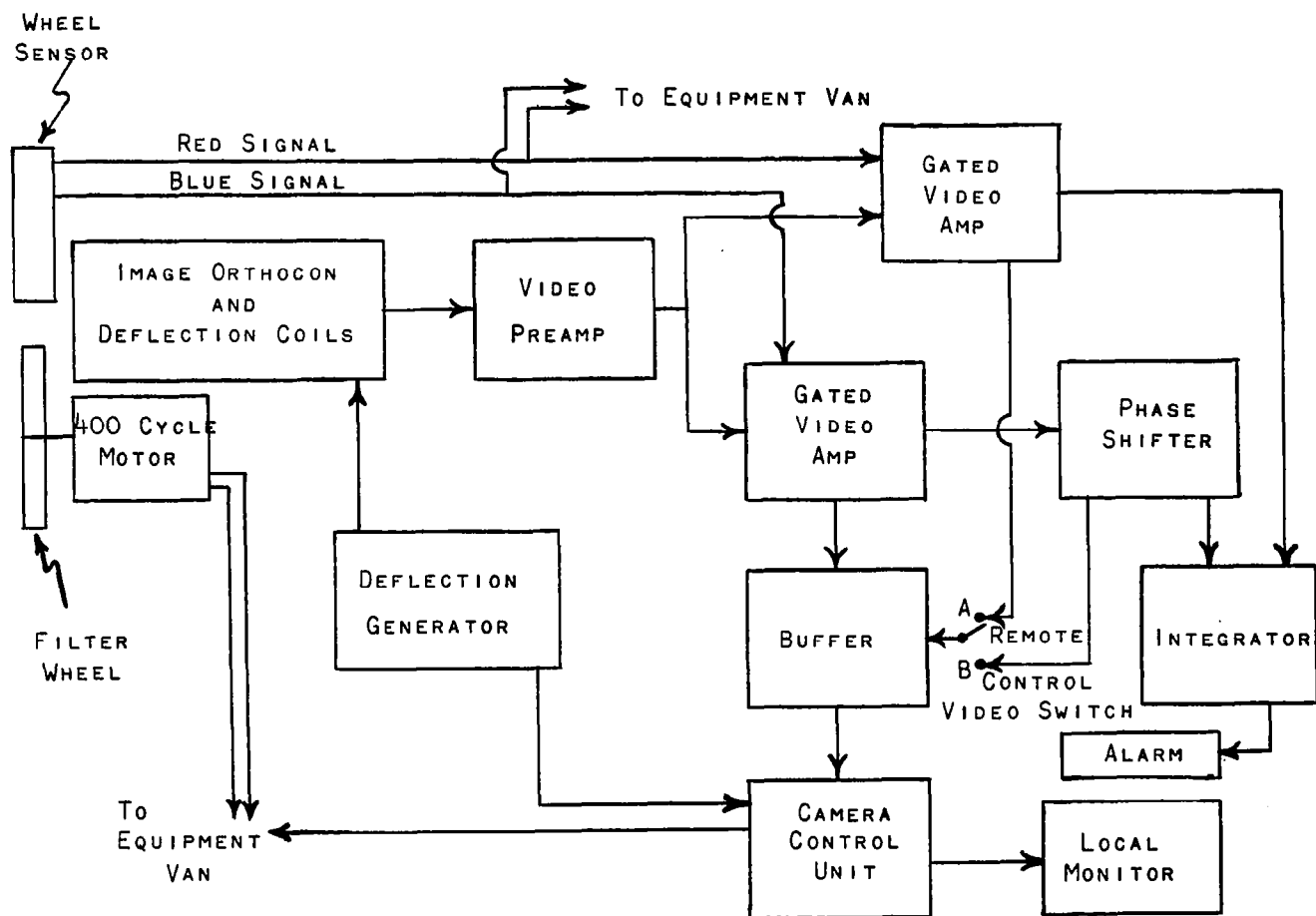
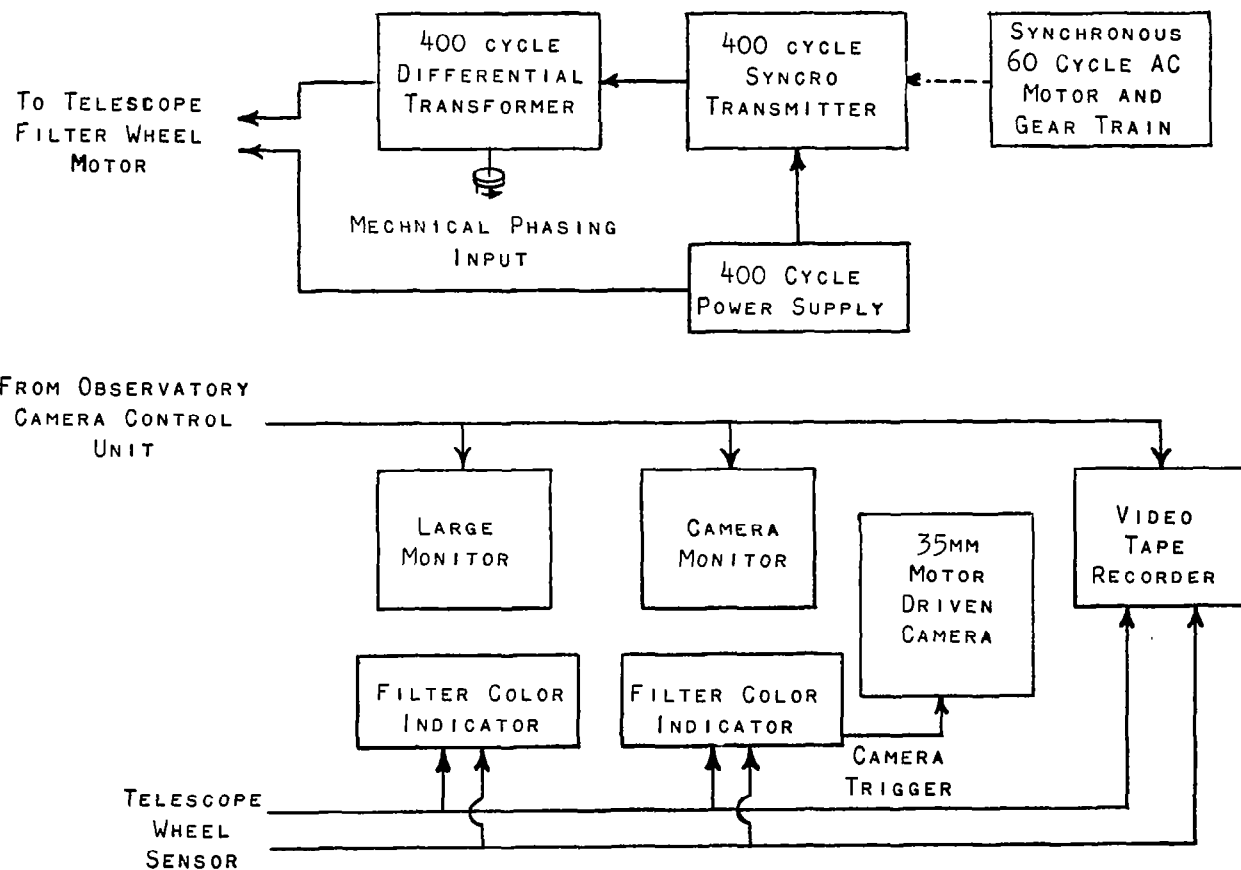FIGURE IX-1. BLOCK DIAGRAM OF AUTOMATIC DETECTOR — OBSERVATORY INSTALLATION

FIGURE IX-2. BLOCK DIAGRAM OF AUTOMATIC DETECTOR - VAN INSTALLATION

APPENDIX X

UNUSABLE OR UNDELIVERED GOVERNMENT FURNISHED EQUIPMENT

From Contract NAS 5-3757, Work Order Nc. 3, P. C. No. 641 W 41080, "Work Statement for Alphonsus (Moon-Blink) Project":

    One Image orthicon system consisting of:
    a. Image Orthicon Camera
    b. Console

- -

From Contract NAS 5-9613, Article IV - GOVERNMENT FURNISHED PROPERTY:

ITEM	DESCRIPTION	QUANTITY	SCHEDULE
11.	Power Supplies H/P 710A	5	One month after Contract Date
12.	Impedance Bridge G/R 650A	1	One month after Contract Date
13.	Voltmeter, Weston 155	1	One month after Contract Date
14.	Tube Tester	1	One month after Contract Date
15.	Generator Sets	2	One month after Contract Date
18.	2½ Ton Shop Van Trucks	2	One month after Contract Date
19.	Preamplifiers	2	One month after Contract Date
20.	Units of Sage Computer including	6	One month after Contract Date

    (a) Digital Display Generator

    (b) Situation Display Generator

    (c) Simplex Console

    (d) Situation Display Console

    (e) Aux Display Console

    (f) Test Pattern Generator

NOTE: Item 19 above was intended for use in the image orthicon system. Items 11, 12, and 20 were to be used for the automatic system prototype. Items 13, 14, 15, and 18 were for use in both the image orthicon and automatic systems.

APPENDIX XI
THRESHOLD OF DETECTABILITY
OF EPHEMERAL LUNAR EVENTS

The practicality of the Moon-Blink concept and the effectiveness of
the prototype equipment installed on the Johnson telescope in Port
Tobacco, Maryland, has been demonstrated on more than one occasion.
(See Appendix III.) However, because the threshold of detectability
of an ephemeral color change on the lunar surface has been questioned
by several groups, NASA assigned the investigation of the problem
to Trident.

In order to simulate the occurrence of a "red spot" on the moon, the
portable Moon-Blink demonstrator described earlier (in 2.1.1 of this
report) was modified for use in initial experiments. The problem
was one of projecting a red spot of variable size and intensity onto
the demonstrator's 35mm lunar slide. This was accomplished by pro-
jecting the image of a pinhole through a hole drilled in the back
of the box. After a series of experiments it became evident that
the infrared component and scattered light could not be controlled
inside the demonstration box. The 4-watt fluorescent lights in a
confined space give rise to a large amount of IR, and the geometry
made very difficult the elimination of scattered light. These
extraneous effects were minimized by mounting the entire system on
an optical bench.

The experimental apparatus in the form utilized for final minimum
perception data is shown in Figure XI-1. Preliminary tests indicated
that, within reasonable limits, the detection threshold was not
largely dependent upon the size of the red spot viewed with the
image tube.

Detector response as a function of hole size was then investigated;
and a red spot on the 35mm slide about three-tenths the size of the
crater Copernicus was selected on the basis of minimum reliable

detector signal.

Measurements at the Johnson Observatory during the July lunation showed that the lunar image, when scanned with a 1P21 phototube, gave an average detector response of 40 microamperes (as measured with a Kiethley Model 150 Micro Volt-ammeter). The final test geometry was such that the initial intensity of the lunar image projected on the front surface of the image converter tube averaged 40 microamperes.

Infrared radiation was still a source of erroneous readings and hence the various infrared filters shown in Figure XI-1 were employed. All Kodak Wratten gelatin filters are quite transparent to the IR. Therefore, the absence of a detectable IR component at the image tube location was determined by a zero detector signal when a combination of a No.29 and a No. 44A filter was inserted in the optical path. The transmission curves of these filters, along with the sensitivity curve of the image converter tube employed, are shown in Figures XI-2, XI-3, and XI-4.

The lunar slide and red spot were focused on the front surface of the image converter tube. The intensity of the red spot was then reduced (by insertion of appropriate neutral density filters in the path of projection) until it could not be detected as viewed with the image tube. This threshold of detectability was confirmed by several different observers.

The applicability of the basic Moon-Blink technique can at this point be shown quite convincingly by the introduction of a rotating filter wheel (filters No 29 and 44A) into the optical path. The spot now blinking is readily discernible.
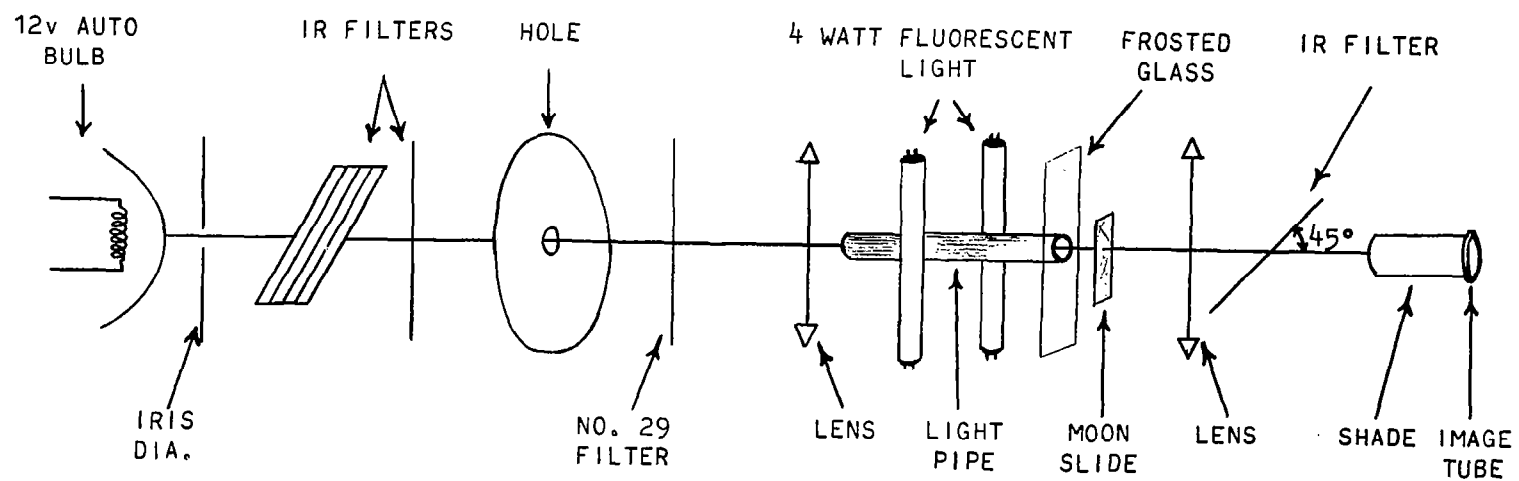
12v AUTO BULB

IR FILTERS

HOLE

4 WATT FLUORESCENT LIGHT

FROSTED GLASS

IR FILTER

45°

IRIS DIA.

NO. 29 FILTER

LENS

LIGHT PIPE

MOON SLIDE

LENS

SHADE

IMAGE TUBE

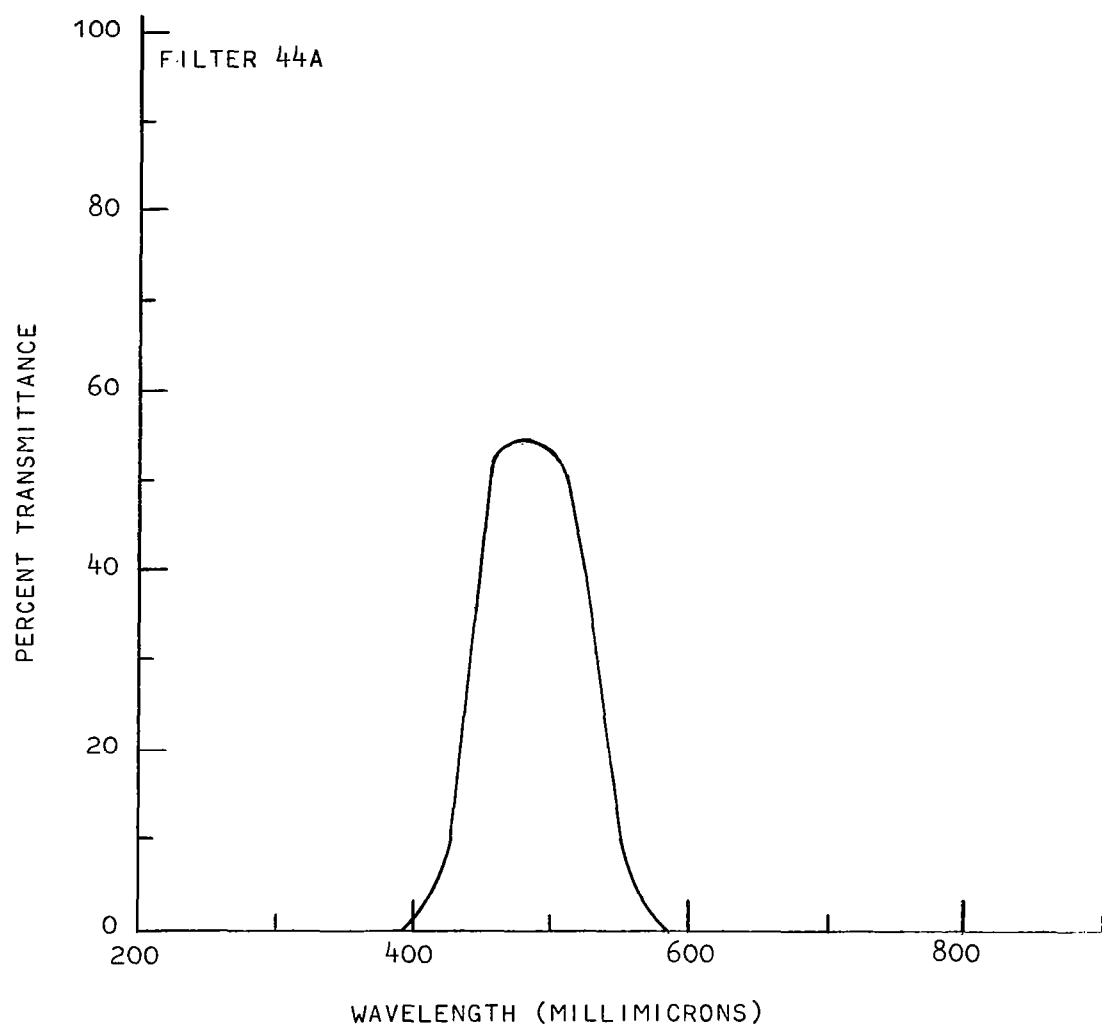FIGURE XI-1. SCHEMATIC OF THRESHOLD APPARATUS

FIGURE XI-2. TRANSMISSION CHARACTERISTICS OF KODAK WRATTEN FILTER NO. 44A.
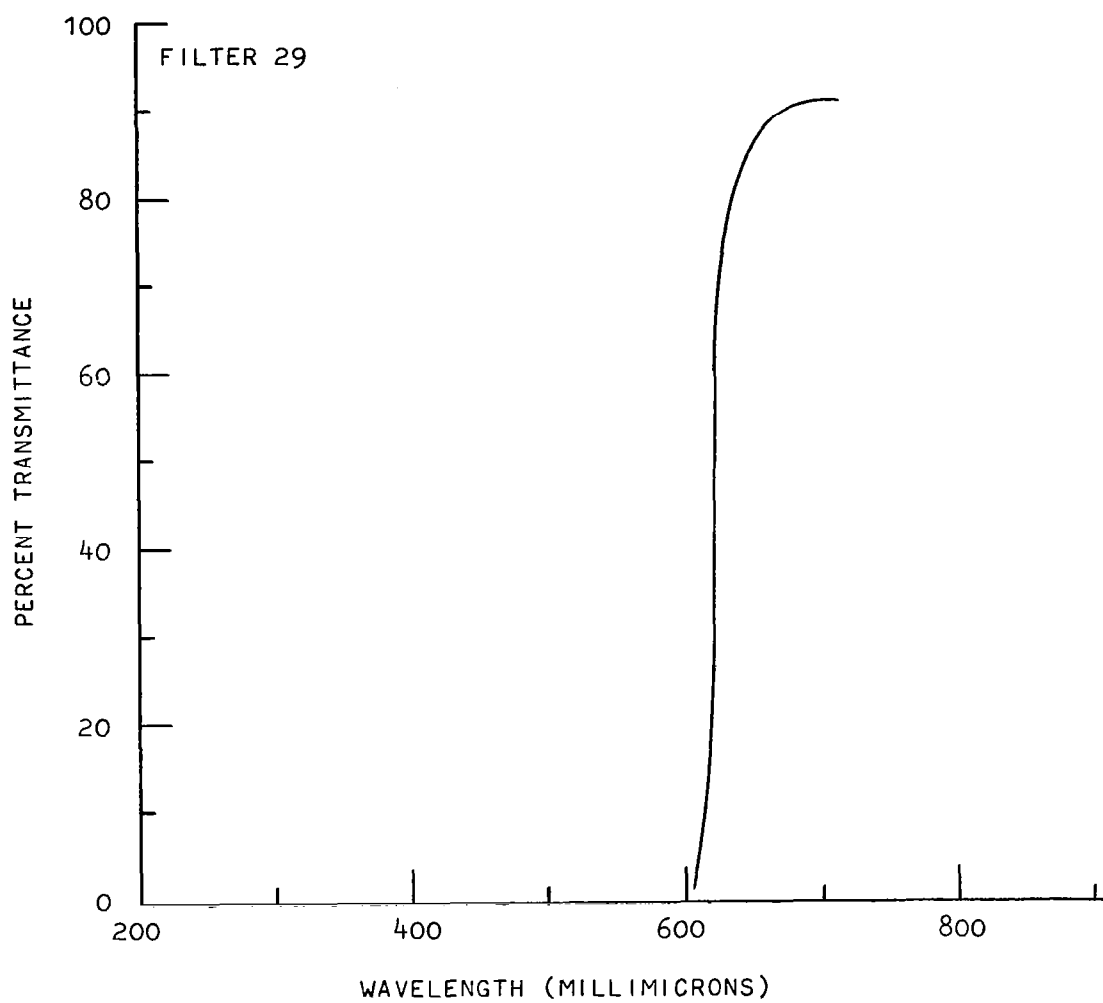
58

FIGURE XI-3. TRANSMISSION CHARACTERISTICS OF KODAK WRATTEN FILTER NO. 29.
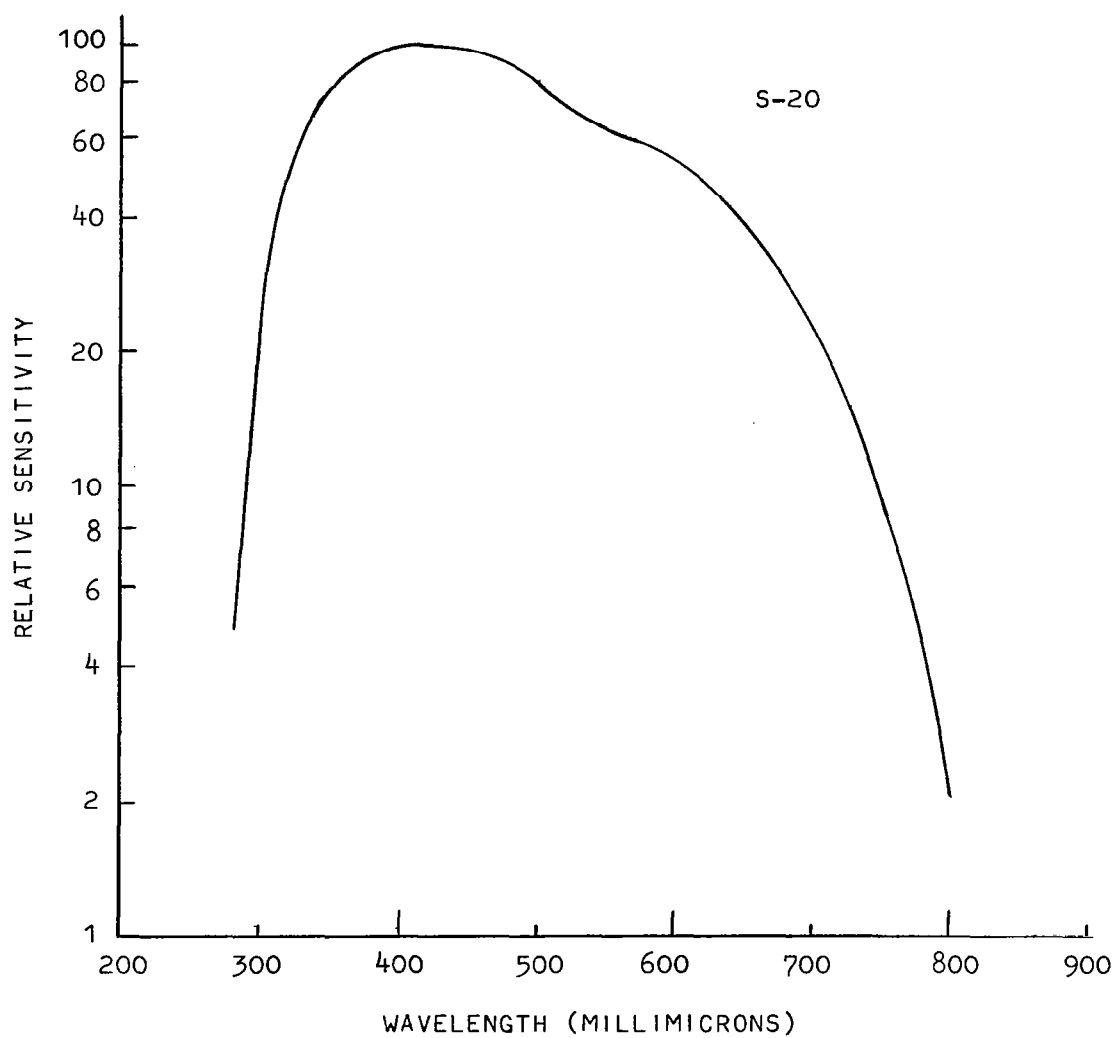
FIGURE XI-4. SENSITIVITY RESPONSE OF
S-20 PHOTOCATHODE.

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The technique employed for the minimum perception measurements begins essentially at this point. The blinking red spot was viewed through the image tube, and various neutral density filters were inserted into the "spot" portion of the optical path. This procedure was continued until the intensity of the blinking spot was such that it was just barely discernible or vanished.

The above experiment was carried out several times with various test subjects, some of whom were experienced lunar observers (on the Moon-Blink project) while others had no familiarity with the "blink" technique. Test results indicated that the threshold intensity for the detection of the blink phenomenon (using the image converter tube) lies between that intensity transmitted by 0.9 and 1.0 neutral density filters.

The data may be put into the quantitative form of Weber's Law.[*]

Where J = the original intensity of the image as measured in the plane of the front surface of the image tube (J comprises the normal lunar background and the projected spot -- the intensity of the red spot being such that it is just undetectable without the blink technique); ΔJ = the difference between the spot when it is just discernible and undiscernible; then Weber's Law states that

$$\Delta J/J = \frac{1}{k}$$

where k is a constant independent of J.

[*]Duke-Elder, Textbook of Opthalmology, The C. V. Mosby Company (1962).
And -
James P. C. Southall, Introduction to Physiological Optics, Oxford University Press (1937).

The variation of the constant is discussed in the references but, as an example, is said to be of the order of 150 for direct sunlight.

The following data were compiled during the course of the experiment.

DETECTOR RESPONSE (Microamperes)

August 3, 1965

			*	**	***	***
Red spot and lunar background through No. 29	22	22	6.21	2.70	1.50	1.45
Red spot through No. 29	10	10	1.85	0.67	0.43	0.35
ΔJ	0.26	0.26	0.048	0.0168	0.015	0.01225
J	22	22	6.21	2.70	1.5	1.45
$J/\Delta J$	85	85	130	161	100	119

August 4, 1965

	*	**	***	
Red spot and lunar background through No. 29	27.6	10.9	5.0	2.4
Red spot through No. 29	13.9	4.70	2.29	1.1
ΔJ	0.36	0.122	0.06	0.029
J	27.6	10.9	5.0	2.4
$J/\Delta J$	77.8	89.4	83.4	82.8

---

* 0.4 ND filter used
** 0.7 ND filter used
*** 1.0 ND filter used

			*	*	**	***
Red spot and lunar background through No. 29	25	21	9.9	8.3	4.2	2.0
Red spot through No. 29	12	9.8	4.5	3.9	1.9	0.88
ΔJ		0.312	0.255	0.122	0.101	0.494	0.0229
J		25	21	9.9	8.3	4.2	2.0
$J/\Delta J$		80.2	82.3	88.4	82.1	85.	87.3

The background is, of course, not reflected sunlight but (except for a few "singularities" due to Hg lines) it closely resembles the light from a W-filament lamp and (importantly, for our purpose) the IR is greatly reduced. The spectrum of the fluorescent background and of a W-filament as "seen" by the 1P21 are shown in Figure XI-5.

The transmission of a 0.90 neutral density (ND) filter was taken to be 0.126, and that of a 1.0 ND filter to be 0.10. To enhance reproducibility of the data, the signals through the 0.90 ND and 1.0 ND filters were calculated as follows rather than being measured.

Typical calculation:

Utilizing the data of August 5, one has: a red spot and lunar background (through the No. 29 filter) signal of 25 μa; and a red spot alone (through the No. 29 filter) signal of 12 a. Hence

$$\Delta J = (0.126)(12) - (0.10)(12) = 0.312$$

$$J = 25$$

and $\quad J/\Delta J = 80.2$

DETECTOR - PM-IP-21 (1150 VOLTS)
SPECTROGRAPH - HILGER E-1 (GLASS)
KEITHLEY ELECTROMETER
EXIT SLIT 70Å AT 5780Å

12 VOLT AUTO HEADLIGHT
@9.2 VOLTS (SEARS)
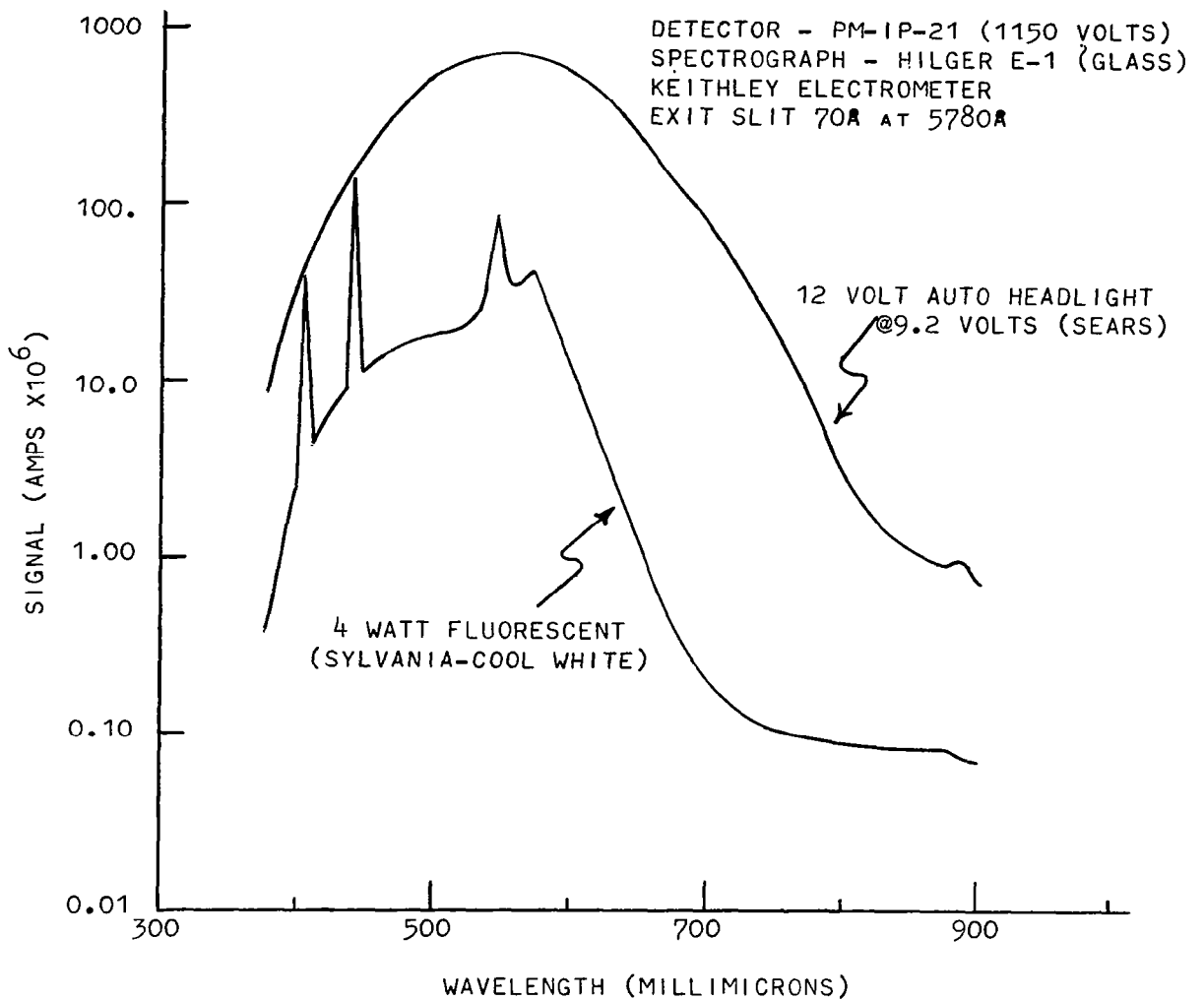
4 WATT FLUORESCENT
(SYLVANIA-COOL WHITE)

FIGURE XI-5. SPECTRAL DISTRIBUTION CURVES.

Inasmuch as the red spot was indistinguishable on the lunar background without the utilization of the blink technique, the value chosen for J was that of the spot and background through the No. 29 filter.

Considering the problem another way, however, leads you to a more astonishing result. You have a lunar image which has an average brightness of X lumens per square foot. Here no red filter is utilized, and X = k x 840 μa. The 840 μa figure was reduced to the previously quoted 25 μa by the introduction of a No. 29 filter. On this image there is a spot whose intensity above background fluctuates from δ to ε [δ = k(0.126)(12) and ε = k(0.10)(12)] and this change can be detected via the blink technique. This gives

$$\frac{J}{\Delta J} = \frac{840}{0.312} = 2690$$

It would seem, however, that the figure of $J/\Delta J = 80.2$ is more realistic.

The color wheel used during all laboratory tests exhibited a slight deliberate background blink. This was done because in an actual observing situation -- due to variations in lunar phase and seeing conditions -- a perfectly matched background is rarely realized.

Should ideal seeing conditions exist during a given ephemeral color phenomenon, and should a very experienced observer be viewing, it is possible that the $J/\Delta J$ of 80.2 could be exceeded. The quoted figures, all of the same order of magnitude, however, represent a realistic approach and should be meaningful during most viewing situations.

SUMMARY

The problem, as initially posed, might be restated as follows: The detection of a weak signal at a narrow fixed band frequency in a wide spectrum of frequencies.

The 44A (blue) filter eliminates the low frequencies (red) which contain the signal and it also reduces the intensity of the high frequencies (blue).

The No. 29 (red) filter eliminates the high frequencies, reduces the intensity of the low frequencies, but passes the signal more favorably than the average of all the low frequencies.

The value of $\frac{signal}{noise}$ for high frequencies is zero in any event. The value of $\frac{signal}{noise}$ for low frequencies is enhanced by the introduction of the red filter.

Rotating the color wheel (when the background is balanced) presents to the eye a spot which rises in intensity above the background once during each cycle. The minimum detectable height of this rise is given, percentagewise, by

$$\frac{\Delta J}{J} \times 100$$

An analysis of the process in terms of electronics would be to say that we have increased the signal-to-noise ratio. Each of the filters reduces the noise. With the No. 44A filter, the signal is completely masked by the noise; and with the No. 29, the signal can be detected when it rises by 0.312 μa above the noise (as a minimum -- when the noise is initially at 25 μa), if and only if it is a pulsating signal.

A more thorough investigation should include quantitative data on the performance of the image tube and an appraisal of the psychology of the "blink" technique.

APPENDIX XII

MICRODENSITOMETER NEGATIVE ANALYSIS

Fifty-nine microdensitometer contour traces were made from the neg-
atives of the November 15th sighting in Aristarchus. The equipment
used was a Joyce, Loebl and Co. Double-Beam Recording Microdensit-
ometer MK-111-B with a National Instrument Labs isodensity plotting
table modification. The machine was made available by Mr. William
A. White of the Solar Physics Branch, GSFC.

The plots were made by scanning the negatives with a 120-micron
square aperture and a scan spacing of 25 microns. The density
range was from 0.5 to 2.0. Density steps were 0.03 per step, with
each transition from line to dot, dot to space, or space to line
being one step. Line to dot to space transitions were increasing
density while line to space to dot transitions were decreasing
density. The linear magnification of the plots was 50 to 1. Fig-
ures XII-1 through XII-4 are typical of these tracings.

Analysis of these plots of the negatives failed to reveal any
indication of the red phenomenon detected by the Moon-Blink Detector.

FIGURE XII-1.   MICROISODENSITY RECORDING OF EXPOSURE #18 TAKEN
THROUGH A BLUE (#44A) FILTER, 1/8-SECOND EXPOSURE
ON TRI-X FILM AT 0230, NOVEMBER 15, 1966 -- 50X
MAGNIFICATION.

FIGURE XII-2. MICROISODENSITY RECORDING OF EXPOSURE #8 TAKEN
THROUGH A RED (#29) FILTER, 1/4-SECOND EXPOSURE
ON TRI-X FILM AT 0230, NOVEMBER 15, 1966 -- 50X
MAGNIFICATION.

FIGURE XII-3. MICROISODENSITY RECORDING OF EXPOSURE #24 TAKEN
THROUGH A BLUE (#44A) FILTER, 1/4-SECOND EXPOSURE
ON TRI-X FILM AT 0325, NOVEMBER 15, 1966 -- 50X
MAGNIFICATION.

FIGURE XII-4. MICROISODENSITY RECORDING OF EXPOSURE #12 TAKEN
THROUGH A RED (#29) FILTER, 1/2-SECOND EXPOSURE
ON TRI-X FILM AT 0230, NOVEMBER 15, 1966 -- 50X
MAGNIFICATION.

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APPENDIX XIII

MOON-BLINK STATIONS RETAINING CUSTODY OF
GOVERNMENT EQUIPMENT

The following Moon-Blink observing stations have each retained in their custody one complete Moon-Blink Detector.

- ° Rocket City Astronomical Association
  Huntsville, Alabama
  Dr. N. F. Six

- ° Kansas City Astronomical Club
  Kansas City, Kansas
  G. L. Tandy

- ° University of Arizona
  Lunar & Planetary Laboratory
  Tucson, Arizona
  C. M. Gillespie, Jr.

- ° Whittier College
  Whittier, California
  Dr. D. F. Bender

- ° Celestronics
  Palos Verdes, California
  F. J. Eastman

- ° Agnes Scott College
  Decatur, Georgia
  L. B. Abbey

- ° Pan American College
  Edinburg, Texas
  Dr. P. R. Engle

APPENDIX XIV

MOON-BLINK EQUIPMENT IN CUSTODY OF GSFC

As directed by Mrs. Cameron (Code 641, GSFC) in her February 28, 1966, letter to Trident, the following Moon-Blink equipment has been turned over to her.

- One complete Moon-Blink Detector

- Two spare image tubes, filter wheels, and other components which will enable GSFC to fabricate additional Moon-Blink Detectors

- Nikon camera with case

- Minolta camera with case

- Spectroscope

- Port Tobacco Log Books